ELECTRONIC SURVEIILANCE

BERSERKER

BOOKS

THE LAYMAN'S GUIDE TO

ELECTRONIC EAVESDROPPING

HOW IT'S DONE AND SIMPLE WAYS TO PREVENT IT

TOM LARSEN

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Warning

This book is *for informational purposes only*. Neither the author nor the publisher condones or is responsible for the illegal use of information contained in this book.

Dedication

To my wife, for her wisdom and patience. Also, to Pat, Ward, and T.M. for helping me break into this industry.

Preface

The purpose of this book is to inform average people about how an individual, or a group of individuals, can successfully spy on them without their knowledge. I will cover some of the basic methods and do it in such a way that a nontechnical person can understand. It is my sincere hope that most people who read this book will be able to prevent themselves from being victimized by electronic surveillance experts.

What is my primary motivation? Too often I meet security personnel, private investigators, and clients who are laboring under a mountain of Hollywood-inspired myths. It is well known to industry insiders that most people who do electronic countermeasures sweeps do not understand the basic parameters of their sweep equipment or phone line basics. Most of them do not even know a transistor from a resistor.

This is not a book on how to wiretap or bug. It is designed to show people how their privacy can be invaded, using the philosophy that "to be forewarned is to be forearmed." I will not dedicate much space to countermeasures. Most countermeasures are just a matter of common sense, and any technical countermeasures should be left to a professional who knows the difference between a transistor and a resistor and how they are used in an electronic circuit.

Sit back, relax, and have a spot of tea as you read this informative book and watch those Hollywood myths fall by the wayside.

P.S. When analyzing any suspected bugging or tapping situation, ask yourself the following question: What are the motive, means, and opportunity of the suspected eavesdropper(s)?

CHAPTER 1

Telephones

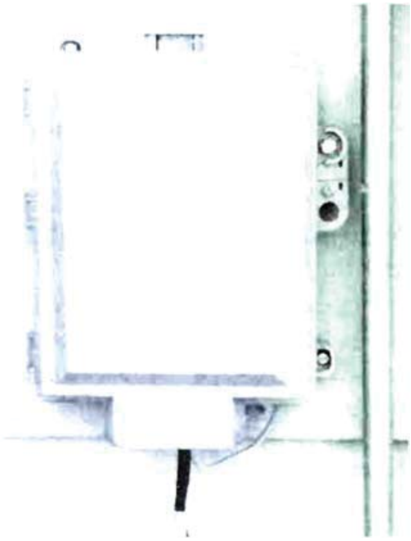
It is estimated that 90 percent of all important details about your life goes out over phone lines. Telephones have "done in" more folks than you can shake a stick at. They can be tapped in dozens of ways at very little cost (in most cases). One hour of recorded phone conversations is equal to ten or more hours of conversation. If a subject is very sensitive and incriminating, do not talk about it over the telephone.

The following is a sample of the ways in which someone might intercept your phone conversations. Let's begin at your home or office and work our way down the phone line and eventually to the phone company's central switching office, or CO for short. I will examine some simple phone line parameters (basics) before we begin.

HOME TELEPHONES

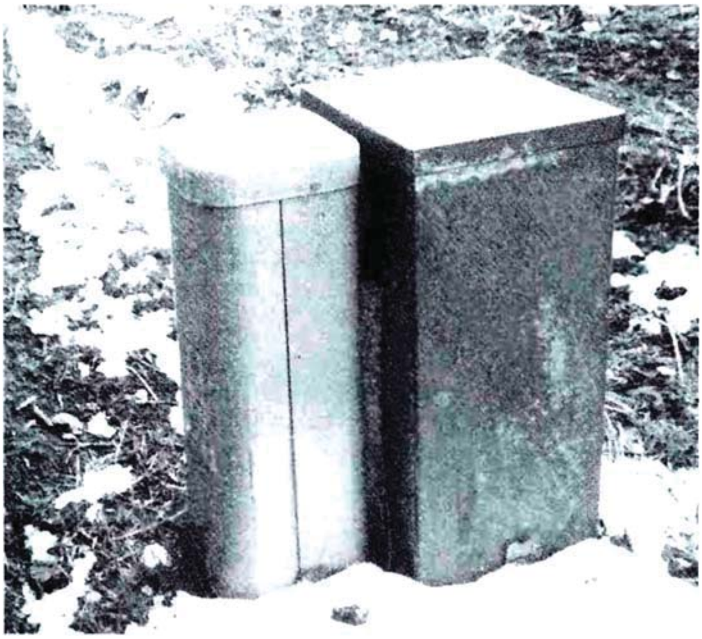
Your home phone plugs into a wall jack. From there the wires terminate at a connector block known as a surge protector, or demark point. The surge protector is usually housed in a plastic (modern) or metal (old style) housing, which is easily opened. The surge protector is usually mounted on the outside wall of the house.

Phone conversations are generally carried out over two wires known as a "talk path." These two



Subscriber interface or surge protector box located on the outside wall of a private residence. This is one of the later versions (late 1980s).

wires start at your telephone and ultimately terminate at the phone company's CO. There may be a half a dozen or more easily accessible connector blocks, which are housed in a variety of metal cabinets on telephone poles or on concrete pads on street corners. These connector blocks are ideal places to place taps off the premises. Many of these connector blocks are housed in cabinets so large that one could hide several tape



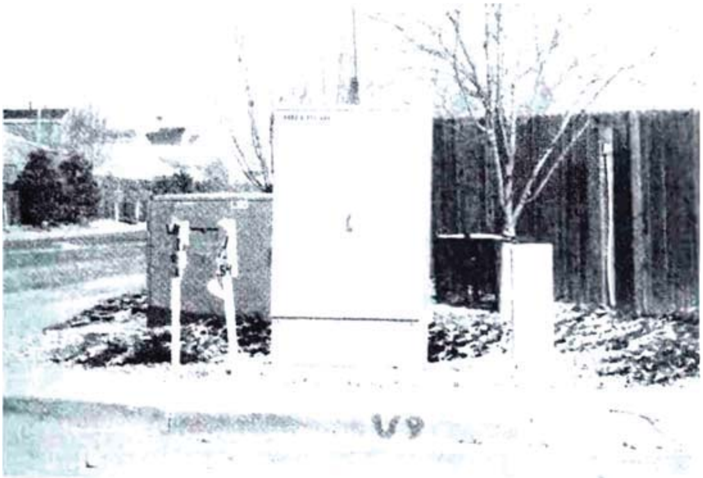
The box on the left is a splice box, or pedestal, for two private residences in an area where there are underground utilities. It contains a connector block where phone lines appear. You'd better pray that this is in your yard and not the yard of a neighbor whom you are feuding with.

This is a splice box in a rural area. It will probably service about a half-dozen subscribers.

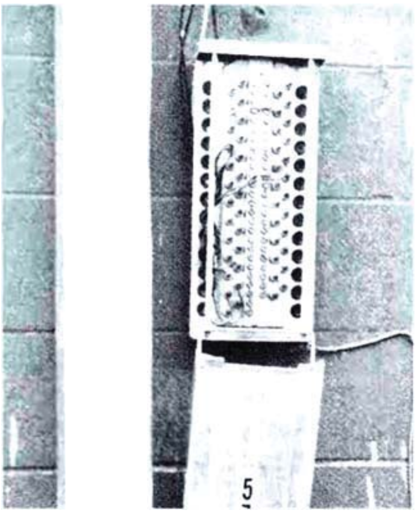
recorders in them (one for each line) with room to spare. When you're out driving around, keep your eyes open for them and you will understand what I'm talking about.

The phone company's CO could be anywhere from 100 feet to 10 miles downwire from your premises. In every major city there are at least two dozen or more COs serving the community. When you talk on the phone with your next-door neighbor, your voice transmission hits the CO, then it goes out of the central switching office on your neighbor's wire pair all the way back to his house and vice versa. Even though your wire pair may be housed in the same cable

CHAPTER 1
Telephones



An area interface box is usually mounted on a concrete pad and is filled with connector blocks containing phone lines. According to phone tech manuals, this should take care of a 1/2-mile by 1/2-mile residential area.



Talk about being vulnerable! This splice box was found behind a small strip mall.

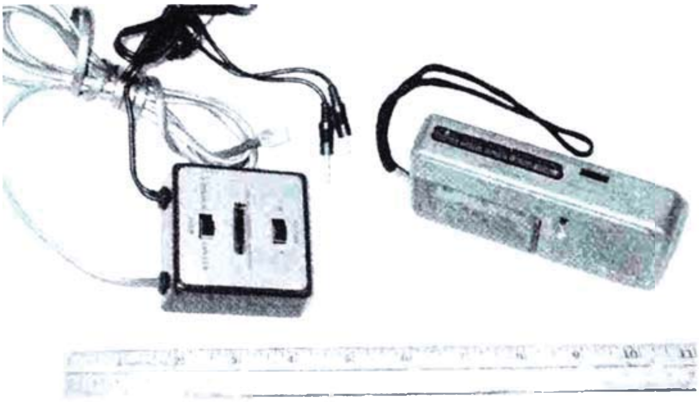
sheath as your neighbor's, all of your conversations go through the central switching office that services your area.

When you talk with someone who is not serviced by your CO, your conversations may hit several central switching offices. When you talk long distance, there is an 80 percent chance that your conversation will be carried on easily intercepted microwave links or satellite links. There are Fortune 500 companies that market microwave/satellite phone conversation/data transmission interception equipment.

When a tap is placed at the central switching office, there is no way to detect its existence—period! Most properly designed and constructed telephone taps cannot be heard or detected with electronic instrumentation when they are placed at the central switching office. There is absolutely no way of detecting whether someone is monitoring the microwave link or the satellite link of a phone conversation/data transmission. You'd better believe that there is, indeed, random monitoring of microwave/satellite phone and data transmissions from time to time by government, industry, and private individuals.

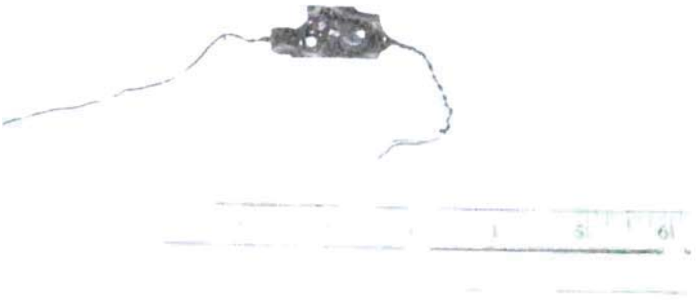
Here is a simple method of tapping that may be employed by a spouse, roommate, or significant other who has access to the premises. They can place an automatic tape starter (which usually costs about $24.95 and is sold at many electronics stores) and a tape recorder behind or underneath a large, hard-to-move piece of furniture that has a telephone jack behind it. They could also place it in the attic or the basement, wherever the phone lines run. All they have to do is cut off the modular end of the automatic tape starter, attach alligator clips, and hook them anywhere across the phone line. For those of you who do not know what an automatic tape starter is, it turns on the tape recorder when the phone is picked up and then shuts the recorder off when the phone is hung up. Its purpose is to tape a conservation without having any "dead tape" time.

A device that very effectively thwarts this kind of phone tapping is a voltage spreader. It keeps the voltage at or above 20 volts DC (direct current), thus keeping the automatic tape starter from turning on. However, these voltage spreaders will not work against voice-activated or radio frequency-type taps.



Goof-proof, cheap, and very easy to use, this system is commonly used by spouses and some professionals to tap phones.

There are some other methods that might be used against you if the phone tapper is technically inclined. Any second- or third-rate electronics hobbyist can build a radio frequency telephone tap for less than $10. In most cases, these taps can be placed anywhere along the telephone line (usually off the premises). Radio frequency taps have a typical range of one to two blocks and broadcast both sides of the phone conversation to any "tabletop" FM radio. The FM radio is then connected to a signal-activated switch and then to a tape recorder. For $10 or less, they can also build a high-impedance automatic tape starter and connect it off the premises, somewhere downwire. When it is properly constructed and terminated, not even the Central Intelligence Agency (CIA) will be able to detect it on the line.



Series radio frequency tap. It draws all of it's power from the phone company and transmits both sides of the conversation up to a block from where the phone is in use.

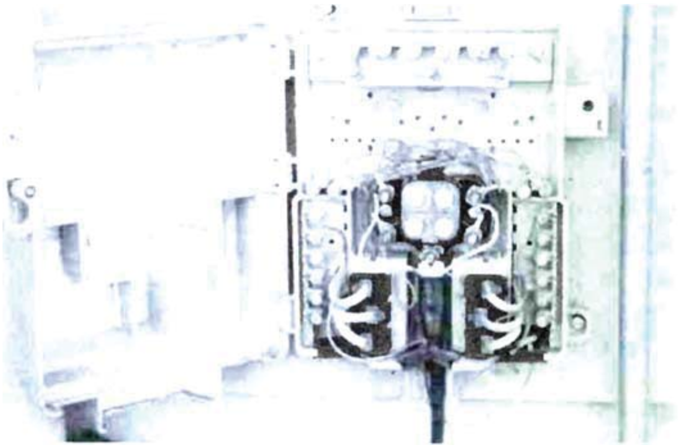
Speaking of not being able to detect certain types of high-impedance, parallel taps on a telephone line, back in the 1970s and 1980s, the federal government started spending incredible amounts of money on Data Encryption Standard (DES) encrypted telephones. Bell Labs and Motorola were the prime contractors and were reported to have charged more than $20,000 for each DES-encrypted telephone for the initial production run. Why? The federal government realized that it could not guarantee the integrity of its own phone lines. When in doubt, encrypt!

Here is a method that can be employed by "rogue" law enforcement types or folks with many resources. The operatives may rent or buy a "listening post" somewhere downwire between you and the central switching office. This may be a house, office, garage, or apartment somewhere down the street. If the utilities are aboveground, the operatives will open up a pole-mounted metal box containing connector blocks and jumper your terminal pair with their terminal pair. In the case of underground utilities, the metal box will be mounted on a concrete pad at a street corner, usually within a half mile of your premises. The act of jumpering your wire pair with a listening post wire pair is called a "bridge job." The operatives can then kick back in a comfy, cozy setting and listen and record the intimate details of your life with relative ease.

Another method that can be used by people with means that is less incriminating is to place a radio frequency (RF) tap on your phone line.

Once the RF tap is in place, they can place an FM radio in a car, complete with signal-activated switch and tape recorder, and park the car within two blocks of the RF tap. The operatives will not have to worry if the RF tap is discovered since it is nothing more than a miniature FM broadcast transmitter, and there is no direct connection to the listening post. Another advantage to this type of tapping operation is that the operatives can move the listening post (a van or car) as needed.

Here is another possible method that, I admit, may be a little bit of a stretch. It is entirely possible that the operatives bribed or "got the goods on" a supervisor from the central switching office that services your premises, giving them the ability to tap your line from the



The inside of a subscriber interface or surge protector box. There's plenty of room for small radio frequency taps to hide.

CO. As stated before, if you're being tapped at the CO, you will not hear the tap, and not even the CIA could detect it on the line.

Telephone tapping is illegal—period. Certain states will not let you record a conversation that you are a party to. My state, Colorado, is a consensual state, which means that I can record anything that I am a party to, as long as I am an active participant in the conversation.

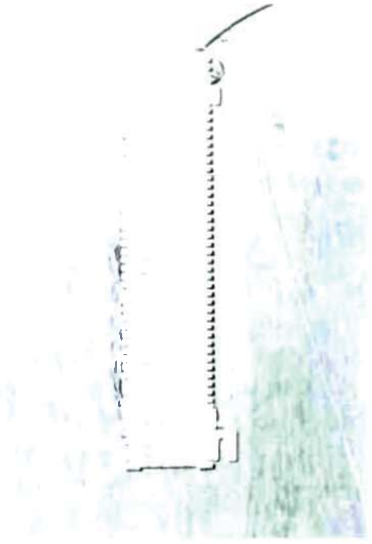
OFFICE TELEPHONES

Tapping of office telephones off premises is not much different from tapping residential telephones off premises. However, there are some differences when it comes to inside wiring and installation of office phone systems. Office phone systems are usually driven by a device know as a "key system unit" that mounts on the wall of a phone closet. In larger systems, it will be a free-standing unit mounted on the floor and referred to as a "switch." Generally, there is one phone closet per floor, and they are usually stacked on top of each other so that wiring can be routed easily.

In a typical phone closet you will find a rat's nest of wires, white R-66 connector blocks, and various key system units, one for each company that occupies a particular floor. As to the purpose of the key system unit: it is an electronic microprocessor-based controller that gives an office all the modern features that most offices cannot live without. It allows you to transfer calls, put people on hold, barge in, conference, use the speaker phone, have music for people on hold, and so on. Now there are also "smart phones" that have all these features built in, but they are usually limited to two or three lines.

Phone closets make excellent tapping points. An operative can get into most phone closets (as of this writing) with a screwdriver. He could just say that he is with a private telecommunications company and make up a ruse that he is doing phone repairs or installation for a company that is a tenant in the building. Most property managers will probably not question him. Of course, using some social engineering and having an honest face will help.

Here is a clever technique that enterprising operatives can employ in a large office building. Suppose the target company has offices on the



A typical R-66 connector block with 25-pair cable in a phone closet.

eighth floor and the operatives find a vacant suite on the third floor at a low price. The operatives gain access to the phone closets from the third floor to the eighth floor and feed a 25-pair cable from the eighth-floor phone closet to the third-floor phone closet. Some of the wires from the 25-pair cable are discreetly attached to the phone lines of interest in the eighth-floor phone closet. At the third floor, the cable is routed above the ceiling tile from the phone closet over to the third-floor office, where wiretaps are conveniently placed. The operatives can be comfortable and have the dual benefit of being able to do physical surveillance on their target as well as wiretapping him.

There's plenty of room for an operative to hide a tap behind a typical R-66 connector block.

CHAPTER 2

Cordless Telephones

The typical cordless phone used in many homes throughout the United States can be intercepted easily by the typical scanner enthusiast. Scanning is a popular hobby in this country. It is estimated that there are 10 million police scanner owners in the United States, which means there is probably a scanner hobbyist on every other block in America. With a typical range of more than a quarter mile, most cordless phone users may be well within range of several scanner owners. Even the cheapest police scanners have the ability to intercept both sides of a cordless phone conversation from more than a block away.

The frequencies of cordless phones were published widely before most of the cordless phones ever hit the marketplace. Scanner hobbyist magazines, electronics magazines, and scanner clubs throughout America sent cordless phone frequency lists to their subscribers. In other words, millions of people with scanners had the frequencies of cordless phones programmed into their scanners back in the early to mid-1980s. For those of you who use or have used cordless phones in the past, please read this paragraph again and weep.

Most cordless phones operate in the frequency range of 46.610 megahertz (MHz) to 46.970 MHz. If an eavesdropper programs his scanner in a search mode from 46.610 to 46.970 MHz, he will be treated to both sides of the conversation. There is a growing number of cordless phones that use the 900 MHz range, as well as those that claim to be "scrambled." But beware, many of the so-called scrambled phones use scrambling techniques that were cracked easily with cheap equipment by electronics hobbyists back in the 1970s. If a scrambled cordless phone uses any kind of "phase inversion" techniques, it's no good. If it uses "digital encryption," it's okay. But keep in mind that wiretappers can always tap the phone line and bypass your scrambled cordless phone.

According to the Electronic Privacy Communications Act (EPCA) of 1986, you have no reasonable expectation of privacy on a cordless phone. Anybody can use cordless phone conversations against you in a court of law. Law enforcement does not need a warrant to listen and record cordless phone conversations. However, if you use a scrambled cordless phone, you have a reasonable expectation of privacy, and law enforcement must obtain a warrant to tap into your line.

In the next section I cover cellular phones. Cellular phones are governed by an entirely different set of laws that hobbyists and law enforcement must abide by. Cellular phones should not be confused with household-type cordless phones. There are significant differences between them.

Update: In October 1995, a law was passed outlawing the monitoring of cordless telephone calls.

CHAPTER 3

Cellular Telephones

Cellular phones, also called "cell" phones, can be intercepted easily by certain types of police scanners. The typical police scanner nowadays does not have cell phone intercept capabilities, but certain brand-name scanners can be modified easily to receive cell phone conversations. Some very expensive and hard-to-find scanners have cell phone intercept capabilities and do not need modification.

Cell phones operate in the 800 MHz frequency range, but they change frequencies quite often when a person is mobile. When a cell phone changes frequency, it is because the person is moving into another cell location. There are hundreds of frequencies in a typical cell phone system, which is quite a hassle for an eavesdropper who is trying to listen in. In a big city, there may be hundreds of cell phone conversations taking place at once in a metro cell system. An eavesdropper would have to sift through hundreds of conversations on a busy work day in order to find his target once he has changed cell locations. Following the frequency change in small towns or isolated communities is easy, like shooting fish in a barrel. But in big cities it's a big hassle.

Computer-aided scanning to the rescue! If an operative has a good scanner with computer interface capabilities, all is not lost. With the addition of a black box, called a DDI (digital data interpreter), and the correct software, an operative can intercept cell phone conversations and follow the call with ease. The cost: $2,000 to $3,000 total, which would include a computer. Law enforcement systems, which have been in use for years, cost $5,000 to $20,000. Certain cell phone companies have installed auxiliary facilities; that is, extra "shacks" equipped with hook-ups for the exclusive use and convenience of law enforcement.

Cell phone frequencies were published in electronics magazines before the phones even hit the market. Tricks and equipment for monitoring cell phones are usually a regular feature in many scanner publications. In 1993, articles started appearing that showed how a cell phone could be "cloned." Someone could actually make a carbon copy of your cell phone or somebody else's cell phone. If a switch is installed, the eavesdropper could turn off the microphone and listen in. But when the target person was done talking, the eavesdropper could turn the microphone back on and then use the cloned cell phone to make calls to Aunt Tilly in Timbuktu. The bill would then be sent to the target.

According to the Electronic Communications Privacy Act of 1986, it is illegal to listen in on cellular phone conversations. Law enforcement must obtain a warrant in order to monitor cell phone conversations.

CHAPTER 4

Pagers

Voice pagers let you leave a vocal message for the recipient, while digital pagers only show a number on the pager.

Voice pagers have provided hours of listening pleasure and fun over the years for scanning enthusiasts. Many voice pages have been intercepted and mayhem has ensued (use your imagination). Here's an example: "Hey John, this is Joe again. You know, the guy from Tile Works Unlimited? Say, John, I goofed. The work order says that you are to lay the green tiles upstairs and the red ones downstairs." (Trust me, I never played this trick on a floor installation contractor.)

Special interception equipment for digital pagers has been distributed to law enforcement personnel for many years. Its cost has hovered in the $10,000 plus range; however, in 1993 a device was advertised in a nationally distributed communications magazine and is being sold to consumers for $400. This device hooks up to a scanner and an optional printer. The consumer can then receive other people's digital pages. So much for efficient use of tax dollars.

Here is a technique that law enforcement personnel can use to intercept pages. When the cops arrest a suspect, they copy down the CAP code (an internal pager company code for each particular pager) and number from the suspect's pager and then give the pager back to the suspect and let him go. The cops could then go down to the pager carrier, warrant in hand. The pager carrier (usually a regional Bell) will make a clone of the suspect's pager for the cops so they can receive every page that the suspect receives. If the cops have a good rapport with the pager company, the warrant process may be bypassed with a wink and a nod. Certain pager companies are very aggressive in their cooperation with law enforcement.

Pager interception can be of great value in the "spy game." It does not take very long to pinpoint movements, times, dates, activities, phone numbers of other suspects, and more. When you have the phone number, you can get the address, if you know where to look. Digital pagers do not offer much more security than voice pagers.

According to the Electronic Communications Privacy Act of 1986, it is illegal to intercept voice pager or digital pager messages. Law enforcement must obtain a warrant.

CHAPTER 5

Fax Machines

Fax machine transmissions are easy to intercept if you have the right equipment. The easy way to intercept fax transmissions is to use another fax machine and attach it to the target's phone line. One could also obtain fax interception equipment from law enforcement supply companies for thousands of dollars; however, private operatives and technophiles have been intercepting fax transmissions at a fraction of this cost. If your phone line is being tapped by a law enforcement agency or by some private party with the means and technical ability, chances are that your fax transmissions are being read also.

Fax transmissions have the advantage of eliminating the "casual snoop" and people with little money or technical expertise. However, if the person or agency has the motive, means, and opportunity, intercepting fax transmissions is a cinch.

It is illegal to tap fax transmissions. Law enforcement must obtain a warrant.

CHAPTER 6

Data Transmissions—Computer Modems

All that applies to fax transmissions also applies to data transmissions. A growing number of people are using DES encryption programs in order to send private messages known as e-mail to their friends and associates. Most DES encryption programs are very easy to use and give a very high degree of privacy for data transmissions. One might ask, who could break a DES-encrypted data transmission? The answer: a federal law enforcement agency with a Cray computer. The time frame: two hours to forever, depending on how the transmission was encrypted. There are some very simple techniques for making DES-encrypted transmissions very secure. One is to double encrypt.

The more people who use DES or stronger methods of encryption, the more difficult it will become for authorities or private operatives to eavesdrop on private data transmissions. When it gets to the point where most people are using encrypted transmissions on the information highway, it's going to be almost impossible for Big Brother to keep tabs on us. Talk about information overload and fried Cray computers!

It is illegal to tap data transmissions. Law enforcement officers must obtain a warrant.

CHAPTER 7

Computer Screens

Some of you are going to have a hard time believing that it is possible to read a computer or TV screen from more than a block away. Decades ago, a man by the name of Van Eck displayed simple homemade equipment that could read a computer screen from a distance. This demonstration was held in a public forum and was not well publicized. "Van Eck" is the term now used widely to describe the technique for reading computer screens from a distance.

A company once offered to sell me a complete Van Eck system for $3,000. For an industrial spy or a government agency, three grand is a drop in the bucket.

Even if you use good communications security, like digital encryption, it is possible for somebody with a Van Eck system to read your message from more than a block away before the message is encrypted. If you are a major drug dealer, mobster, or an outspoken radical who believes very strongly in the U.S. Constitution and you are using DES encryption on a regular basis, government agents will probably use a Van Eck system against you.

The only known way to prevent Van Eck eavesdropping is to use Tempest Standards. (Van Eck is also called "Tempest Attack.") Tempest Standards are a complicated form of shielding and grounding to prevent stray electromagnetic fields from emanating beyond computer and other communications devices. You must know what you are doing if you are going to employ Tempest precautions. You could build an expensive Tempest room, only to find out too late that you forgot to unplug the phone line from the modem before you encrypted a critical message. Believe it or not, a phone line, an electrical line, or a water pipe leading into the Tempest room can act as an antenna.

You're probably wondering if I have actually seen a real Tempest Attack. Quite frankly, no. However, I have run some crude tests and interviewed many individuals over the years whom I trust, and I am convinced beyond a shadow of a doubt that it is possible to read a computer screen from up to a block away. For those of you who are still skeptical, consider this question: why has the government created a Tempest Standard and spent hundreds of millions of dollars on Tempest Attack prevention? I rest my case.

CHAPTER 8

Covert Video Surveillance

As of 1994, electronics hobbyist magazines were advertising video cameras that are 1 inch by 1 inch by 1/2 inch and video transmitters the size of a quarter and 3/8 of an inch in thickness. Add a 9-volt battery and you can transmit video up to and possibly exceeding a one-block range. Just imagine the possible hiding places: ball caps, stuffed animals, table lamps, radios, TVs, motor vehicles—the variety is limited only by one's imagination.

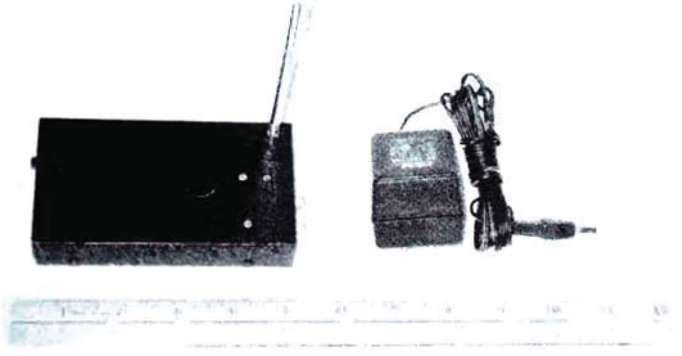
Some well established companies install pinhole lens video cameras. These companies have been installing covert video systems in retail stores, offices, industrial facilities, and government buildings for many years. This is a big business, and it's far more widespread than security personnel care to admit. Covert video cameras can be built into sprinkler heads and passive infrared motion detectors. Pinhole lenses can be installed in a ceiling in such a way that you could stare at the ceiling for hours and not be able to see the lens.

What is particularly disturbing about these systems is that they can be installed by virtually anybody, without requiring any technical skill beyond the ability to use a screwdriver. The price is well within the reach of the typical consumer. At this writing, there are no laws against video surveillance in the United States, with the exception that you cannot install it in a bathroom or any kind of changing room.

The U.S. government has had the ability to read a newspaper headline from a satellite for many years now. From a satellite "heat signatures" can be read anywhere under its "footprint." In layman's terms, if you're on a mission in a wilderness area, or even an abandoned urban area, and you start a small campfire or light a small camping stove, even inside a small, uninsulated building, it will show up. Furthermore, these satellites make regular heat signature comparisons, and they will alert their operators.

Satellite technology has progressed to the point that it can detect a definite heat signature difference between cut vegetation and live vegetation. If you are sleeping in a tent, your general outline can be seen from a satellite. Some possible ways to avoid these satellite intrusions are to conduct your operations on a very cloudy day or night, sleep in a cave, or stay in a heavy forest with a thick canopy of live vegetation above you. You could also heap a layer of dirt on a small abandoned building and use it as a temporary refuge. A cheap aluminized mylar survival blanket, sold at sporting goods stores, can do wonders when used properly.

Video cameras that were marketed in the 1980s were rather bulky, and they did not work very well in low light conditions. By the late



Video transmitter with 100-yard range. This can be used with a small CCD video camera and a 9-volt battery pack. There are units available (with miniature video camera included) that are a quarter of the size shown here.

1980s, surveillance buffs started to discover that the new charged coupled device (CCD) video cameras could operate well under low light conditions. CCD video cameras have another advantage over the standard tube type consumer-grade video cameras—they can be made much smaller. Because of CCD technology, the small size that I described earlier was achieved.

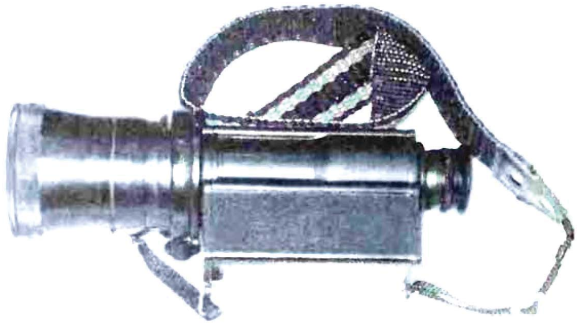
Spotlight with infrared lens. With the lens on, you cannot see any light with the naked eye. When you use it with a night vision scope, you can illuminate a suspect in a dark corner of a yard or an alley without his being aware that he is being observed.

CCD video cameras can see infrared light sources. An infrared TV remote looks like a little penlight through a CCD video camera. A surveillance operative who needs to get choice video under very low light conditions will use a CCD video camera and an infrared light source. The light source could be as simple as a spotlight with an infrared filter covering the spotlight lens. An unsuspecting person can be fully illuminated and not have a clue that every move he makes is being observed with ease using CCD video or night vision devices. (You cannot see infrared light with the naked eye.)

There are two very general terms for describing night vision devices.

> 1) Active—This type requires an infrared light source in order to be of any use. This was the first night vision device.
>
> 2) Passive—This type is commonly referred to as "starlight," because it only requires starlight or moonlight to operate. It will actually amplify starlight and moonlight by a very large magnification factor. It's been around for decades and is the most popular of the two. Starlight scopes have adapters that permit their use with tube-type video cameras. Starlight scopes can be enhanced for very low light situations by adding an infrared light source.

Let's do a little "reverse engineering." If you obtain a starlight scope (for $500 from Russian surplus), you can scan your rooms, yard, and neighborhood for any infrared light sources. Perhaps you can also get a glimpse of someone sneaking around your neighborhood with your night vision scope. It's fun and educational to scan one's "turf."



Surplus starlight night vision scope. It's great for spotting infrared light sources. You can see an infrared bug or an infrared remote control from more than a block away at night.

CHAPTER 9

Bugging

There are hundreds, perhaps thousands, of ways to bug conversations.

AMATEUR BUGGING

The following are samples of the ways in which an individual with limited funds and limited technical skill could bug a room.

The amateur bugger could purchase a wireless baby monitor and hide it in his home, office, apartment, or other room of interest behind a large, rarely moved appliance or piece of behind a large, rarely moved appliance or piece of furniture. He can be up to a block away and listen in on all the conversations in the room of interest with the companion receiver, which is normally sold with the baby monitor. Baby monitors are quite sensitive, and they are usually crystal controlled, which prevents frequency drift. However, they tend to be a little bit bulky.

The supervisor of an office or warehouse could buy an intercom system, either wired or wireless, and put the master unit in his office and the slave unit in an employee's work area. The supervisor could cleverly conceal the slave unit in the employee area if he is worried about its being discovered. He could then sit back and listen in on the employee's conversations. How many of us have fallen victim to this trick over the years?

Wireless studio or lapel microphones are readily available at certain electronic outlets and audio-visual rental shops. The cheap units have up to a 300-foot range, and the expensive units have up to a 1/4-mile range under the right conditions. Some of the very expensive units are drift free, use two antennas, and are called "diversity microphone systems."

Wireless microphones are like miniature broadcast stations. Legally, they should be worn on your body—that's why they are also referred to as "body mics." I have seen some cheaper units demonstrated and can attest to the fact that if you set them down in a room, they will pick up a whisper from 15 feet or more and broadcast it up to 200 feet away. Most of these studio or body mics come with a companion receiver. Some nasty people have been known to hide these mics in rooms.

• • •

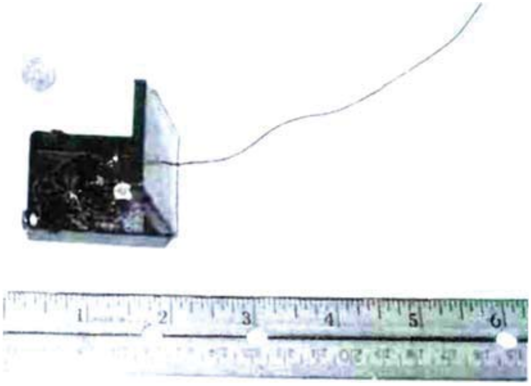
The three devices listed above are very inexpensive. Wireless baby monitors are available for $60 or less, wireless intercoms for $80 or less, hard-wired intercoms for as little as $15, and cheap body mic systems for as little as $49 (including body mic and receiver). These products are usually available seven days a week all over the United States. Wireless baby monitor reception can be greatly improved by using a police scanner with an outside antenna instead of the supplied receiver.

Professionals who use crystal-controlled (drift-free) transmitters will typically use a scanner.

Operations

Here are some examples of how an amateur might operate. He could buy a bug through underground sources or purchase a bug kit with some assembly required from various suppliers that advertise in electronics magazines. Believe it or not, it is illegal to possess or transport a device that can be "primarily useful" for eavesdropping purposes; however, it is legal to sell or buy a bug or tap in kit form. Baby monitors, intercoms, and body transmitters are exempt from the law, as long as they are used in the manner for which they were intended.

If a person is able to use a soldering iron and is mechanically inclined, he will not have to know electronics in order to assemble some of

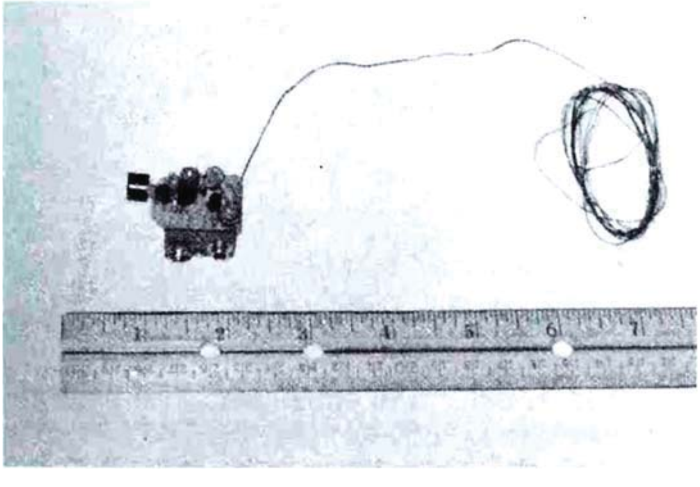


This small bugging transmitter can be thrown together with $4 worth of parts. It uses a small button cell battery and can pick up a whisper from 20 feet and broadcast it up to 1/2-mile away.

these kits; however, frequency adjustment for their ideal operation can be quite difficult. He could hire an electronics technician to assemble the bug kit and do the necessary adjustments in order to avoid any technical difficulties.

Many commercial bugs and kit form bugs are very small, usually 3/4 inch x 1/2 inch. Most of the time, the 9-volt battery that the bug is attached to is actually much bigger than the bug. An operative has a distinct disadvantage when using battery-operated bugs because they tend to use up the battery in three days or less, depending on the efficiency and overall design of the bug. Small bugs that use AC (alternating current) power are rare and are quite a bit more difficult for the amateur to place.

The transmission range of most bugs is 200



A typical 9-volt bugging transmitter.

feet to 1 mile, depending on the transmitter's design, terrain, antenna, and the receiving setup. Do not believe advertised transmission ranges. Incorrectly adjusted bugs may only transmit up to 50 feet, or not at all.

Techniques

An operative could place a bug anywhere in a room in a hidden location, preferably away from large metal objects. Close proximity to

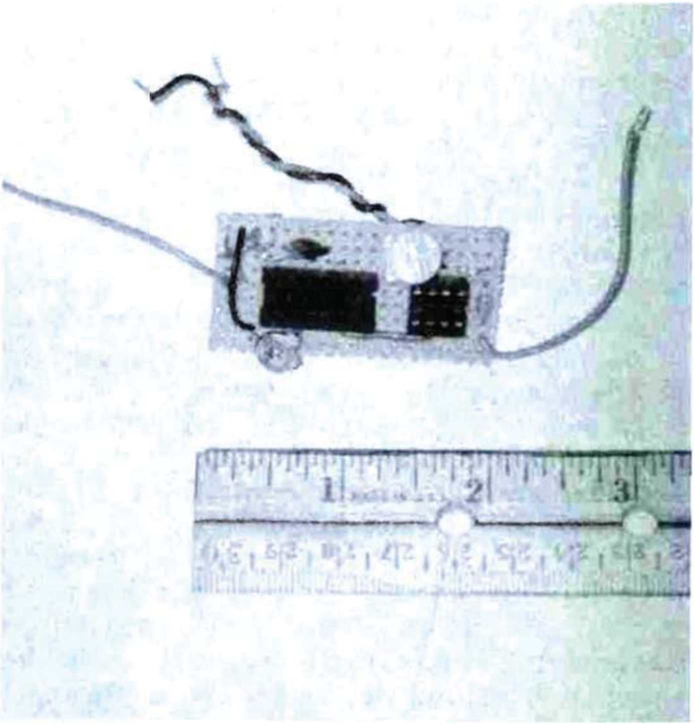
Amateurs and some professionals will typically use a standard tabletop portable radio with or without an automatic frequency conrol (AFC). Radios with standard analog tuning are required when the transmitter is not crystal controlled.

metal objects can be very disruptive to small bugging transmitters. The operative could connect two or more batteries in parallel for greater transmission time, that is, four days instead of two. The hiding places for bugs this small are too numerous to list. They are limited only by one's imagination and mechanical/ electrical ability. Once the bugging transmitter is placed, all the operative has to do is set up a listening post. The listing post could be a vehicle, rented office, garage, house, or apartment. A tabletop portable FM radio, a signal-activated switch, and a tape recorder is all that is needed for automatic operation.

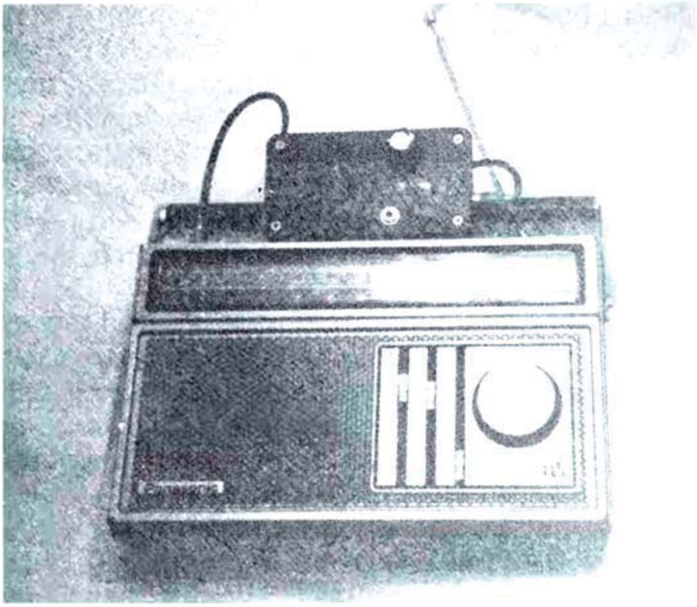
A variation of the above technique is a properly placed VOX (voice-operated) transmitter and a radio with a VOX tape recorder. The beauty of this system is that the bug does not transmit unless someone is talking or making noise. Detection of a VOX-operated bug is somewhat reduced since it is on only when someone is talking. When someone walks into the room and starts talking, the VOX-operated transmitter starts transmitting to the FM radio at the listening post and then the VOX-operated tape recorder starts to record. It is totally automatic and relatively simple to do.

Can you think of any ways that these automatic recording systems can be sabotaged? (Think before you peek ahead to the next sentence.) You could turn on a radio, TV, or stereo and just leave it on all day and night. The poor bugger will have tape after tape of nothing but garbage. Chances are, any sensitive room conversations will be garbled if a TV or stereo in the target room is turned up loud enough. It is very difficult to listen in on conversations in the presence of loud background noise. Even the pros have a difficult time filtering out loud background noise and separating it from the conversation.

Another time-honored method of bugging by



Subcarrier converter. This unit (integrated circuits removed) can easily convert any 6- to 18-volt bugging transmitter to subcarrier operation.



Tabletop portable radio with homemade subcarrier decoder on top.

an amateur is to use carrier current transmitters that use very low frequencies (below the AM broadcast band). These transmitters use a building's wiring for their power and signal path. They rarely transmit much beyond the building that they are installed in. The operative could rent an office or apartment in the target's building and then hide a carrier current transmitter in the target's room. The beauty of this system is that the transmitter will last indefinitely, and most so-called countermeasures personnel probably will not detect it.

Most over-the-counter counter-measures gear is not designed to detect these low frequencies.

Most generic hidden transmitter locators sold in the United States will not work very well in urban and suburban areas due to the high levels of radio frequency energy floating around. A good countermeasures team will always use a spectrum analyzer, which looks similar to an oscilloscope.

Another technique that might be used by an amateur is a very unique bugging device that has been around since the early 1960s. It has many names, but here are just a few: "infinity transmitter," "harmonica bug," and "coast-to-coast transmitter." Back in the 1960s and 1970s, before the phone company switched over to its new electronic switching service (ESS) system, an infinity transmitter could be connected to a phone line and hidden in a room on the target's premises. The operative could call it from anywhere in the world, send a certain tone with a portable tone generator over the phone line, and the device would answer and treat the operative to all the conversations in the room—all without disturbing the normal operation of the phone or alerting the target. The infinity transmitter would answer before the first ring. When the target picked up the phone, everything would go back to normal again.

Once the phone company upgraded the phone system from the old crossbar system to the new ESS system, the older infinity transmitters became useless and could only be used on a second dedicated line. Certain companies have redesigned infinity transmitters so that they will work on the new ESS phone systems; however, they have certain telltale signs: one ring and then less than two minutes later, another ring. If the target picks up the phone after the first ring, it will disrupt the operation of the device, causing the operative to initiate another activation cycle. In other words, he will have to start all over again.

If an operative uses an old-style infinity transmitter with the new phone lines, the phone will ring once and then anybody who tries to call while the infinity transmitter is activated will just get a busy signal. Another problem that can occur when somebody tries to call is that the phone will ring only once and the infinity transmitter will answer. The poor caller will be treated to five to ten seconds of room sounds or conversation before the "timeout" (hang-up sequence). The new generation of "smart" infinity transmitters will disconnect when someone calls, thereby allowing the phone to ring.

The old-style infinity transmitters still have their uses, though. Many homes, apartments, and offices have extra phone lines wired throughout them. All an operative would need to do is hook up an infinity transmitter and conceal it in the target room. After it is hooked up to a spare phone line wire pair, the phone company can be called and told to activate the spare line and assign it an unlisted phone number. The phone bill for this extra line could be sent to a dummy address or even to the target. I doubt if most people would ever notice if they were being billed for an extra phone line.

PROFESSIONAL BUGGING

Now let's look at how a pro might bug someone. Most of the hidden transmitter methods that were mentioned previously will probably take on a new dimension.

Operations

The pro may build or obtain a circuit that will make any battery-operated transmitter AC operated. In other words, it will operate off of 110-volt AC house current and last indefinitely. The pro might build or buy circuits that will allow him to shut off the bug remotely if he hears a person conducting a countermeasures sweep. He may hide many bugs, some very obvious that are meant to be found and others very well hidden and shut off remotely. If a transmitter is shut off remotely, there is nothing to detect.

The pro may use exotic modulation methods for his transmitters that might not be demodulated or detected by most countermeasures teams. A countermeasures team may think that what it is detecting is just junk or some kind of interference.

A pro might also use a very low-power transmitter that may slip past detection. Because there are so many radio and TV signals floating around most metro areas, a low-power transmitter signal might get lost in the shuffle, so to speak. The pro could use a simple relay setup: a low-power bug, a nearby receiver (75 to 200 feet away), and a more powerful relay transmitter connected to the receiver, which then retransmits to another receiver located much farther away (two blocks to two miles).

Techniques

A pro might use "hard-wired" techniques, which simply means that the microphone is wired directly to the listening post where the tape recorder is sitting. There are microphones that you would need tweezers to handle, and they can be connected with either very fine wire or conductive paint. A real clever pro might install a tiny microphone, run a long length of

This power converter converts most 6- to 12-volt transmitters to AC operation. Most over-the-counter adapters do not work—this does. (Sorry, not for sale.)

fine wire to it, and then hook up the wires (at the other end) to a hidden transmitter. When the countermeasures team conducts a sweep, it will probably not detect anything because the transmitter is some distance away.

Contrary to what you may have been told by Hollywood or security professionals, microphones cannot be detected without a good physical search. They do not radiate any detectable fields. I have experimented with high-powered ultrasonic fields and high-frequency response tweeters, and I was never able to make a microphone squeal—not ever. If you know somebody who thinks that you can find hidden microphones consistently by bombarding them with ultrasonic sound generators, send them to me and I will sell them a bridge in Brooklyn.

A pro may use a transmitter that is way up in the gigahertz frequency range, beyond the detection capabilities of the typical electronics countermeasures jockey. He may also use a bug that is very low in frequency—200 kilohertz or less. Many electronics countermeasures experts do not have equipment that will detect anything that low in frequency.

Government agents may use some of the techniques as the pros but with these added dimensions: slightly smaller units that are 10 times more expensive. The results are usually the same: intercepted conversations, electronic countermeasures teams with egg on their faces, and very angry clients, some of who end up in the Gray Bar Hotel wearing stripes or orange jumpsuits.

CHAPTER 9
Bugging

A technique that federal agents have used for years is to hide a pulse burst transmitter in a target's room or office. The pulse burst transmitter stores up conversations and then sends anywhere from seconds to minutes worth of conversation out in one data burst, lasting for a brief instant. The "off air" duration is much longer than the "on air" duration. In other words, it does not transmit very often, which makes it hard to detect. I would like to see the local "rain dancer" who does not know a transistor from a resistor try to find a pulse burst transmitter using a generic hidden transmitter locator.

Another technique used by feds and international spy rings that has been around for decades is passive bugging. It consists of a microwave transmitter and a resonant cavity. The resonant cavity is nothing more than a microwave frequency resonant stripline and a microphone. It has no semiconductors or components at all. It is basically a small circuit board and a microphone. Passive bugs can be built into art objects, walls, or ceilings. They do not need a power source. An operative could be a block or more away and direct a microwave beam at the passive bug and then listen in on any room conversations. Most countermeasures teams will not detect a passive bug job. The Russians pioneered this technique in the 1950s.

Laser bugging is very similar to passive bugging. A laser beam is directed at a window, essentially turning the window into a transducer (microphone). The reflected signal is received at the listening post with a telescope and a very simple light wave receiver. Electronics hobbyists have been experimenting with laser bugging systems for years. They are cheap and relatively easy to assemble. However, the audio quality is fair at best, depending on the window's construction and nearby road noise.

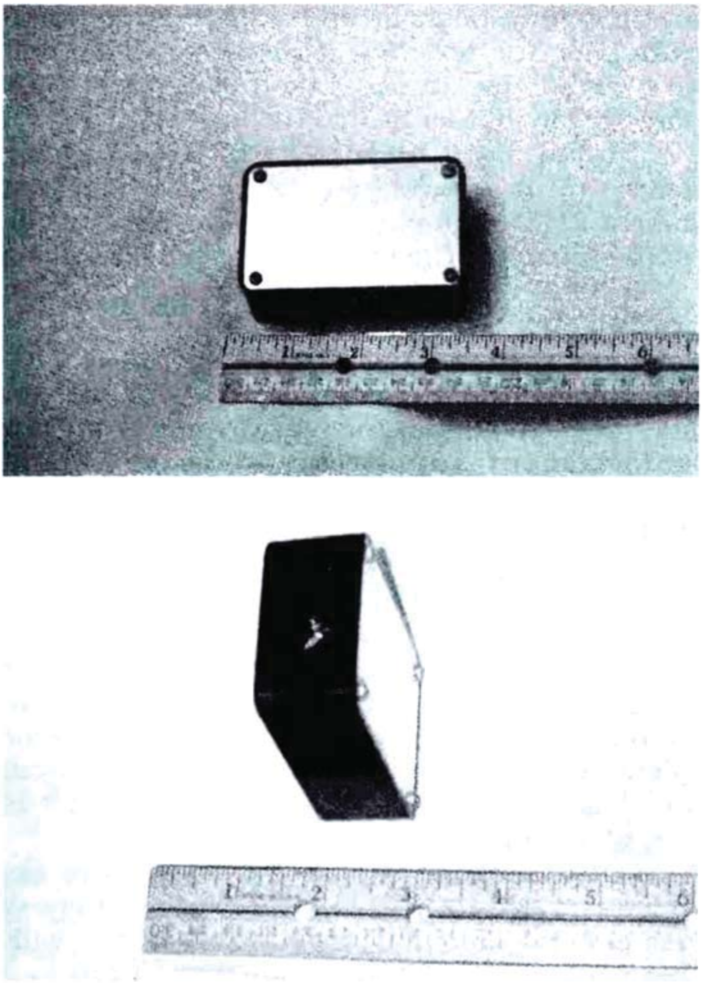
Here is an interesting method that a pro or government agency may use. Some small infrared bugging devices measure 1 inch by 1 inch by 1/2 inch and can pick up a whisper from 20 feet away and then transmit that whisper on an infrared light beam to a listening post one or two blocks away. As stated before, you cannot see an infrared beam with the naked eye. There is one very big problem with this type of bugging system: it requires absolutely accurate line of sight alignment. However, there is one very big advantage to this bugging system: it won't be found by most electronic countermeasures teams.

A transmitter and receiver for an infrared bugging system can be built for less than $25 by a good electronics hobbyist. It may not be as small or as pretty, but it will do the job. I have seen homemade units that are as small as a pack of cigarettes. An operative could hide the unit in another room or even outside the building and then run a very thin cable to a tiny microphone hidden in the target room.

A simple countermeasures trick to detect laser bugging devices is to use a surplus ($500 or less) night vision scope in order to spot the listening post. If you are brave enough to visit

CHAPTER 9

Bugging



Cigarette pack-sized infrared bugging transmitter. It has a provision for a remote microphone. It is hard to aim and even harder to hide, but it will be missed by most countermeasures technicians.

the listening post, bring a rather large friend with you. The pros use lasers with beams that are not visible to the naked eye. Never look directly into a laser beam.

To find out if there is an infrared bugging device in or around your home or office, just take a night vision scope and scan the outside of the building. The infrared bug will look like a little pocket flashlight beam emanating from the building.

Here is another method of bugging used by law enforcement and pros. There is a device that has been available for many years from law enforcement suppliers and underground sources. It's commonly referred to as a combination room monitoring and telephone tap transmitter. This device is small enough to be installed inside a typical telephone. When the phone is hung up, the device will transmit any room conversations, and when the phone is being used, it will transmit any phone conversations. You might call it a "double your pleasure, double your fun bug." The typical advertised range on this type of transmitter is two blocks or more.

Let's not forget vehicle bugging. There are some very effective bugs made just for bugging vehicles, which are usually placed in line with the vehicle's radio antenna. These units are typically sold to law enforcement complete with an automated receiving system.

CHAPTER 10

Bumper Beepers

A bumber beeper is a small tracking device that is placed in or around a vehicle and transmits an intermittent beep via radio frequency. This radio signal is then received with radio direction finding equipment.

The typical bumper beepers sold to security personnel and private investigators usually have disappointing transmission ranges. Never believe the advertised ranges of transmitters. I personally tested two systems in the past, and I was very disappointed. The typical range in a suburban neighborhood was one to two blocks.

In an urban (big city) environment, the range was less than one block. Almost all of the private investigators I have interviewed since the early 1980s have also stated that they were very disappointed with the bumper beeper systems they had used.

Law enforcement tracking systems are quite an improvement over the typical systems sold to private investigators. The Federal Communications Commission gives much more leeway to law enforcement when it comes to power output (higher power equals longer range) and frequency of operation. Systems made exclusively for law enforcement have ranges in excess of 5 miles for land vehicles and 20 miles or more for aircraft.

Some law enforcement tracking devices have rather unique features and can be activated remotely. Some units transmit a short series of beeps and then shut down for 5 to 15 minutes. If the unit shuts down for this long, a countermeasures team will probably not detect the tracking device. Most people assume that tracking devices transmit a steady series of beeps and do not expect them to have a long shutdown period. Sometimes these units are hidden in contraband cargo.

For those of you who own a police scanner, here are some general frequency ranges for you to scan.

> 30 MHz to 46 MHz (local and state police)

153.74 MHz to 156.24 MHz (local and state police)

158.730 MHz to 159.465 MHz (local and state police)

162 MHz to 174 MHz (federal government)

406 MHz to 420 MHz (federal government)

453 MHz to 454 MHz (local police and government)

460 MHz to 460.625 MHz (local police)

Try using a search mode and lots of patience. In the frequency ranges listed, you will hear a variety of communications: undercover, local and state government, and possibly bumper beepers. In the federal government frequency ranges you may hear transmissions that sound like a rush of white noise followed by a high-pitched "ping." The white noise is DES encryption—more than likely the agency is using Motorola brand two-way radio units for voice communications.

By law, you must keep communications interceptions to yourself, unless it's a Mayday (distress) call.

CHAPTER 11

Miscellaneous

Some large modern office phone systems have some severe vulnerabilities that operatives who are familiar with these systems can exploit. Some systems have a feature known as "executive override." When this feature is programmed in by the telecommunications technician, the top executive can call any extension in the building, punch in a special code, and then listen in on any employee's phone conversation. The executive does not have to be in the building—he could be calling from anywhere. The technician can also disable the "executive override alerting tone" so that the victim would not be aware that somebody was listening in.

These systems can be turned into infinity transmitters with proper programming and some physical modifications. Simply stated, someone could call in from the outside (anywhere) and access the "hands free" feature of the speaker phone. Just imagine, someone on a beach in Maui being able to call your extension and listen in on your office conversations. These techniques have been known to professionals for many years now. Some of these systems have major brand names, which I will not mention here. Hackers love a challenge, and I am quite certain that many technophiles are aware of these modern office phone system vulnerabilities. It's just another playground for them.

There is a simple bugging technique that turns the typical residential telephone into a standing microphone. The operative can modify a residential telephone in several minutes or less and can sit safely downwire with a portable amplifier or tape recorder and listen to your room conversations. Most people would never notice this modification. There are also spike microphones and uniquely designed transducers that can turn a wall or heating and cooling duct work into a microphone.

Since the 1960s, the phone company has had a system known as Automatic Message Accounting (AMA). This system keeps a record of all calls made, local as well as long distance, and makes a time, date, and number dialed record, even on local calls. The phone company was very tight-lipped about AMA for many years, even with the authorities.

Any trash left at the curbside is "fair game," according to the supreme court. Professional garbologists have told me that they can gain a wealth of information from someone's trash. It would be a good practice to destroy utility bills, memos, and any personal correspondence instead of throwing them out.

CHAPTER 12

A Message Encryption System for Everyone

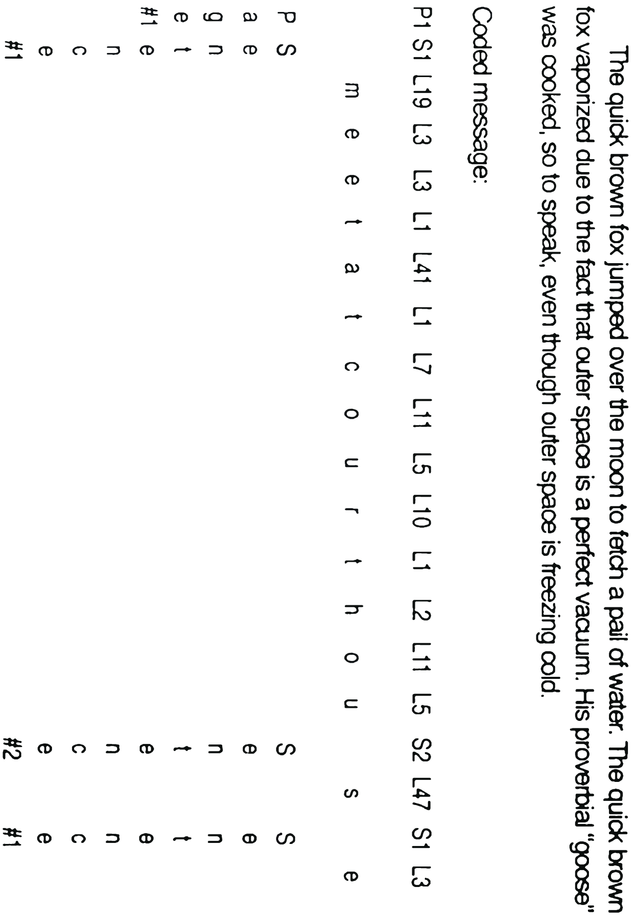
Here is a very cheap and effective way to send messages, either verbal or written.

1) Buy two, very old, identical obscure books or magazines.

2) Hide one of them in an old notebook, newspaper, or brown paper sack, and hand it to one of your trusted associates.

3) The code goes like this:

P# means page number
S# means line or sentence number (I prefer line number)
L# means letter number



The quick brown fox jumped over the moon to fetch a pail of water. The quick brown fox vaporized due to the fact that outer space is a perfect vacuum. His proverbial "goose" was cooked, so to speak, even though outer space is freezing cold.

Coded message:

P1 S1 L19 L3 L3 L1 L41 L1 L7 L11 L5 L10 L1 L2 L11 L5 S2 L47 S1 L3

m e e t a t c o u r t h o u s e

Page #1
Sentence #1
Sentence #2
Sentence #1

The story of the spaced-out fox.

Cumbersome? Yes. Secure and cheap? A definite yes. For security reasons, do not designate any space or demarcation between words. Your associate at the receiving end should have the smarts to separate the words. The old, identical books or magazines (known as the "keys") should be changed every now and then. This code is nearly unbreakable as long as the enemy does not know what books or magazines you and your associates are using.

CHAPTER 13

Dirty Tricks to Play on Buggers and Tappers

The following is a list of simple dirty tricks to play on eavesdroppers.

1) Turn radios, TVs, and stereos on. Most bugging devices will be overwhelmed and the audio quality turned to mud with loud-playing home entertainment devices. Stand or sit close to the person you are conversing with, and keep your voices down. Make sure that

the person is not wired.

2) Use writing pads. If the people doing the bugging have good audio filtering (processing) equipment, use writing pads and burn or flush the top sheet and the sheet underneath the top sheet.

3) If you leave a home or office that may be bugged, leave the radio or TV on. Any voice-activated bugging devices will turn on and record many hours of garbage.

4) Use different phone booths. You and your associates should have some prearranged phone booth locations. Do not discuss phone and meeting locations on a phone that you think may be tapped.

5) Take the phone off the hook on a random basis, and place the handset close to a stereo speaker playing some totally obnoxious music. Just think of the many hours of listening pleasure that some poor wiretapper is going to be subjected to.

6) Avoid using cordless phones, and insist that your contacts avoid using them.

7) Use a voice disguising telephone. It will make your voice totally unrecognizable. This defeats voice analysis and is less incriminating. The price of voice disguising equipment has really dropped (it's less than $100 now).

8) If you are having a meeting and discussing sensitive subjects in either an office or a residence, unplug the telephone from the wall jack. This will defeat any telephone instrument modifications.

Warning: Most generic hidden transmitter locators and wiretap detectors do not work very well in most situations. Other than a very expensive TDR (time domain reflectometer, a sophisticated cable fault locator costing $5,000 and up), all of the generic telephone line tap detectors that I have ever tested are worthless when detecting phone line taps off premises.

CHAPTER 14

Common Misconceptions

MISCONCEPTION #1: "I have been told that a good countermeasures team can tell if my telephone is tapped at the phone company's central switching office."

FACT: False. Electronically, there is no way to tell if there is a tap at the CO. The electrical characteristics of the phone line may vary from one central switching office to another. I have personally seen situations where 300 feet off the premises a phone line was interfaced with a T-1 carrier system, which will read like a parallel connected wiretap. A T-1 carrier system is a sophisticated method for putting multiple conversations and fax/data transmissions on one phone line pair and is used by the phone company to save on new telephone line installation expenses. It is generally used when the cost of running new lines is very inconvenient or cost prohibitive. Central switching office equipment will look like a telephone tap on a TDR.

MISCONCEPTION #2: "Some people have said that they can hear most telephone taps."

FACT: This wild (but common) misconception almost warrants not being dignified with an answer. Unless some wiretapper is a complete moron and is using defective equipment connected in an improper manner, there will be no audible noise generated by the tap. Most of us can hear an extension phone when it is lifted from the cradle—a drop in the audio level occurs because of a drop in voltage across the phone line. However, most telephone taps, no matter how simple their construction, will be totally inaudible to the victim.

MISCONCEPTION #3: "I have been told that there is a number that I can dial that will tell me immediately and with certainty if my phone is tapped."

FACT: The only deserving answer for a person who believes this one is, "I have some oceanfront property for sale in Arizona."

MISCONCEPTION #4: "Any countermeasures team chosen at random from the phone book will be able to find a telephone tap on my phone line, assuming it has been tapped."

FACT: False. There are at least three methods of telephone tapping that will not be detected by the best, most sophisticated intelligence agencies in the world. One method costs $50, one cost $5 or less, and one costs 50¢ or less. The only way to find these devices is to inspect every linear foot of cable from the phone to the central switching office. Not only is this physically impossible, you would be trespassing on phone company property. In the case of underground utilities, not even the CIA would be able to get permission to dig up miles of phone cable. Most countermeasures teams do not know a transistor from a resistor and do not have a clue as to the basic phone line electrical parameters.

MISCONCEPTION #5: "Any countermeasures team should be able to tell if my telephone has been bugged."

FACT: False. Certain telephones on the market, which may be identical to the one you are currently using, have been altered in such a way that not even the company who manufactured the phone could tell if it was modified for bugging purposes. It has been reported that the small network boxes in the older style (2500 series) phones could be replaced with modified network boxes that will place room conversations on the line when activated remotely. A physical search will do no good in these situations.

MISCONCEPTION #6: "It is my understanding that a countermeasures team should be able to debug my home or office in two hours or less."

FACT: False. A half a day to one full day is typical. Anything less than four hours would make me suspicious of the countermeasures team.

CHAPTER 15

Choosing a Countermeasures Person

Here is a short list of questions that you should ask a prospective countermeasures person.

1) Does he know the basics of the frequency spectrum, basic frequency allocations, and basic propagation characteristics of commonly used frequencies?

2) Does he own a police scanner and use it on a regular basis? Is short-wave listening and scanning

an ongoing hobby of his? If not, was it ever his hobby at any time?

3) Does he know the approximate band width of his radio detection equipment (hidden transmitter locators)?

4) What kind of equipment does he use to find hidden trans-mitters? Does he use a spectrum analyzer?

5) If he does not use a spectrum analyzer, does he at the very least use a near field receiver along with various radios that cover a wide portion of the frequency spectrum?

6) Will he let you watch? If not, definitely call someone else!

7) Did he tell you that there are certain bugs that cannot be found unless you literally tear the place apart?

8) Has he done any electronic experimentation and design work?

If he answers "no" to any of questions 1, 2, 3, 5, or 6, search for another debugger.

If your main concern is with phone tapping, here are some questions you should ask.

1) Has he ever done any office or residential phone installation?

2) Does he understand the basic electrical characteristics of

phone lines: voltage, current, impedance, and so on?

3) Is he aware of the fact that certain taps cannot be detected?

If his answer is "no" to any of these questions, look for someone else. Beware, he might lie about his experience. *Do not talk on a phone that might be compromised!*

CHAPTER 16

Legal Considerations

I learned early on in the countermeasures business that your chances of winning the lottery are greater than finding a lawyer who is knowledgeable about communications privacy laws. I have met many private investigators, lawyers, and security personnel who are not even aware of the fact that bugging and tapping are illegal. Most people do not realize that you must be a party (participant) to a conversation in order to record it, according to federal law. Certain states do not allow you to record conversations even if you are a participant. It would be a good idea to check state as well as federal laws.

Back in 1968, Congress enacted the Omnibus Crime Control and Safe Streets Act. This law made bugging and telephone tapping illegal. Before this law was passed, it was a "free for all" for inquisitive minds. I remember there being catalogs filled with ads for bugging transmitters and a wide variety of telephone tapping devices for sale prior to 1968. According to the law (not actual practice), the only people who can bug and tap anybody are those in the government, provided that they have a proper warrant signed by a judge.

In 1986, Congress brought us a "new, improved" communications privacy law, updated for the new communications technologies. This law is called the Electronic Communications Privacy Act of 1986. For the first time in the history of the United States, certain frequencies were made illegal to monitor. Cellular phone monitoring and certain pager modes were declared off limits to people with scanners. Many valiant constitutionalists argued intelligently against this draconian provision, but in the end, the cellular lobbyists with briefcases full of political action committee (PAC) money won the battle against them.

The constitutionalists argued that if you want privacy, you should encrypt your communications. Since these communications are broadcast over the public airwaves and permeate our homes, offices, and bodies, we have a right to monitor these frequencies. Old TVs and VCRs do a fair job of picking up nearby cell phone conversations, so how do you police this absurd provision in the law? The bottom line is, cell phone companies can now sell their clients a false sense of security at the expense of our constitutional rights.

In the ECPA of 1986, Congress allowed the monitoring of household cordless phones because they use the public airwaves and "you have no reasonable expectation of privacy." (No PAC money here!)

It is estimated that for every legal, court-ordered electronic surveillance conducted by law enforcement, there are at least 100 illegal electronic surveillance operations conducted by lawmen, which are known as "wildcat" operations. Can this be proven? Not in our lifetime. One way that it can be proven theoretically is as follows: The number of court-ordered electronic surveillance operations conducted by law enforcement each year is a matter of public record. If you look at the number of suppliers of spy gear, sold only to law enforcement, and do a rough estimate of their production capabilities, you will find that 100 to 1 is not so farfetched.

It is a matter of public record that 800 to 900 court-ordered electronic surveillance operations are conducted by law enforcement each year. Now here is one of my favorite examples of how we can prove the 100 to 1 (or more) theory: If a one-man shop can produce 5,000 bugs and taps per year with weekends off, then imagine what a company like AID of Florida, which makes surveillance equipment for law enforcement, can produce with its 200 employees and its economies of scale. There are dozens of companies like AID around the globe that sell to law enforcement only.

Most of us streetwise countermeasures folks just about fall out of our chairs when we see these published statistics on the number of court-ordered wiretaps. If you have some long talks with honest ex-lawmen, you will quickly realize that these 800 to 900 reported court-ordered electronic surveillance operations are just the tip of the iceburg. Perhaps 100 illegal operations to 1 legal operation may be understating the fact.

YOU AND THE PHONE COMPANY

It is illegal for the phone company to notify you if law enforcement is tapping your phone line legally. The problem with this is that phone company personnel do not know whether it is a legal tap or not. Phone workers do not want to risk jail time, so what do they do? They keep their mouths shut. They tell you that everything is okay. If it looks like a law enforcement tap, they will say that they found nothing.

According to the ECPA of 1986, the phone company, long-distance companies, and private switchboard operators can legally monitor your conversations in order to spot check the quality of the line and to prevent fraudulent use of their facilities. Does anyone see any potential for abuses here? Like ratting you out to the government or getting an insider trading tip from listening to your conversation with a stockbroker?

CHAPTER 17

The Future of Telephone Tapping

At some point in the near future, the phone company is going to replace copper wire phone lines with fiber-optic cable. A handful of areas around the country already have fiber optics in place, but most of us are still serviced by copper wire.

It is going to be very difficult for most wiretappers (at this writing) to tap fiber-optic cable. It will require highly specialized technicians with very expensive equipment. Just because someone is adept at assembling a small fiber-optic network purchased from some electronic hobby magazine does not in any way qualify him to be able to tap a fiber-optic cable.

Can a fiber-optic cable be tapped? Yes, definitely. But consider the following: Let's say that you are authorized to tap into a fiber-optic cable. You will find a large bundle of tiny glass fibers, each carrying a potential of thousands of communications per tiny strand. What strand do you tap? When you find the proper strand, you may find hundreds, if not thousands of communications taking place. You will then need some fancy digital equipment in order to select and demodulate the signal of choice. In addition, there may be a sophisticated alarm system in place that will detect a fault or tap in the fiber-optic cable. It will be a lot easier to tap the line at the victim's premises or at the central switching office that services the victim's premises.

The U.S. Congress signed a bill into law in August of 1994 that forces the phone company as well as pager and long distance carriers to upgrade their facilities in order to make it easier for law enforcement to tap phone conversations and fax and data transmissions. When the upgrades are complete, the government will be able to tap phone and fax machines remotely, without having to go to the phone company central switching office. Phone company personnel will be oblivious as to which of their clients are being tapped.

THE CLIPPER CHIP

As of this writing, the government is trying to push the clipper chip on the American people. The government wants this chip to be installed in phones and fax and data transmission equipment. It will encrypt communications, thereby keeping them private. The fatal flaw in it is that the government will have the back door to your communications, although the government will allegedly use a warrant in order to access it and decrypt your communications.

Contrary to a popular rumor floating around, switching to a conventional (analog) type phone will not offer you any protection when the clipper system is in place. Analog phones are very easy to tap.

CHAPTER 18

Interesting Frequencies to Monitor

Please note that frequencies and their uses are subject to change without notice. Do not repeat any communications that you intercepted with your scanner.

WIRELESS BODY MICROPHONE FREQUENCIES

Law enforcement is authorized to use the following frequencies for wireless body microphones:

169.445 MHz
169.505 MHz
170.245 MHz
170.305 MHz
171.045 MHz
171.105 MHz
171.845 MHz
171.905 MHz

Keep in mind that law enforcement may use other frequencies as well. Their range is one city block or less.

Private operative and federal law enforcement wireless body microphones have been reported on the following frequencies.

72 MHz to 76 MHz
174 MHz to 216 MHz

These are usually "diversity" wireless microphone systems that use two receiving antennas at the listening post. Most scanners do not receive these frequencies; however, if you have a tabletop portable radio that covers television channels 2 through 13, just tune slowly through the blank channels. Many electronics stores have a large inventory of radios that tune in TV sound for channels 2 through 13, and most cities have TV channels that are not in use, for example, channels 3, 5, 8, 10, 11, and 13 in Denver, Colorado. Most modern scanners have very fast search rates. It is illegal to monitor federal body transmitters.

Do not forget to search these federal, state, and local government and business frequencies:

30 MHz to 50 MHz
108 MHz to 144 MHz
148 MHz to 174 MHz
215 MHz to 512 MHz
894 MHz to 960 MHz

ELECTRONIC APPLIANCE STORE WIRELESS BODY MICROPHONES

These units operate on 49 MHz to 50 MHz and have limited power and a limited range (a half block or less).

With a good scanner and a tabletop radio that tunes TV channels 2 through 13, you should be able to uncover most body transmitters manufactured and sold throughout the United States. In order to listen to wireless body microphones and hidden transmitters, you will generally need to be within a one block radius. An outside antenna will help.

If the operative is using a hidden tape recorder, scanners, radios, and bug detectors will do you no good.

VEHICLE TRACKING DEVICES (BUMPER BEEPERS)

Some police and federal agencies use bumper beepers in the 30.86 MHz to 31.98 MHz frequency range shown below. As stated before, these units may only transmit a short series of beeps once every 5 to 15 minutes. Some patience is required in order to detect these beepers.

30.86 MHz
30.90 MHz
30.94 MHz
30.98 MHz
31.02 MHz
31.06 MHz
31.10 MHz
31.14 MHz
31.18 MHz
31.22 MHz
31.26 MHz
31.30 MHz
31.34 MHz
31.38 MHz
31.42 MHz
31.46 MHz
31.50 MHz
31.54 MHz
31.58 MHz
31.62 MHz
31.66 MHz
31.70 MHz
31.74 MHz
31.78 MHz
31.82 MHz
31.86 MHz
31.90 MHz
31.94 MHz
31.98 MHz

(Notice that the spacing is 40 KHz or .04 MHz.)

The Federal Bureau of Investigation (FBI) has been reported using frequencies 40.17 MHz and 40.22 MHz.

The Secret Service has been reported using frequencies 406.75 MHz, 407.80 MHz, 408.50 MHz, and 408.975 MHz.

The Bureau of Alcohol, Tobacco, and Firearms (BATF) has been reported using frequencies 165.5125 MHz and 170.4125 MHz.

The U.S. Customs Service has been reported using frequencies 164.4625 MHz, 164.8625 MHz, 165.4875 MHz, 166.6625 MHz, and 166.8625 MHz.

Be sure to search out frequencies adjacent to and in between the frequencies listed.

The famous LoJack anti-car-theft vehicle tracking systems use 173.075 MHz. When the police get a stolen vehicle call, a transmitter activates the LoJack bumper beeper. Each bumper beeper has its own unique activation signal that it receives. When activated, the bumper beeper transmits a tone every second. The police use radio direction finding equipment to locate the stolen vehicle. Obviously, not all vehicles are equipped with LoJack systems. Less than half of the states have LoJack systems in place at this writing.

This is by no means a complete list of bumper beeper frequencies. It is just a list of some of the more active frequencies reported around the country.

CHAPTER 19

Conclusion and Some Final Thoughts

This book is not intended to show all of the electronic bugging, tapping, and counter-measures techniques available—just the basics. If you have read up to this point and thoroughly studied this book, you probably know more than most investigators and security personnel. If an operative is determined and has the resources, nobody, not even the CIA, can protect your phone line or the intimate details of your life from being betrayed.

I did a short stint in the telecommunications industry, and I have interviewed various telecommunications workers over the years. I found out that the phone company installed a lot of redundant wire pairs around many metro areas, known as "leftovers." These leftover wire pairs may appear anywhere. For example, there may be an extra cable wired in parallel to your home or office phone cable, which may appear down the street in a phone closet, basement, attic, or crawl space coiled or punched down on connector blocks. These provide excellent wiretap points—very ominous indeed.

If you're dealing in very sensitive matters, you and your associates should look into DES encrypted communications systems. DES encryption programs are very easy to use. If you're not into computing, then just use writing pads and do not forget to burn or flush the sheets when they are no longer needed. Do not throw memos in the trash.

HOW TO BUILD A

BUGPROOF ROOM

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CHAPTER ONE

MY GOOD FRIEND THE LAWYER

A sekret ceases tew be a sekret if it iz once confided—it iz like a dollar bill, once broken, it iz never a dollar again.

—"Affurisms" (1865) from *Josh Billings: His Sayings*, Henry Wheeler Shaw (1818-1885)

My good friend Robert is a criminal-defense lawyer. He specializes in defending persons who are charged with serious crimes. Most of his work is to assure that each client receives a *fair* trial, and he aggressively exploits the rights of his clients. Robert is well-known and successful. His law practice has always been in compliance with the ethical canons of the American Bar Association and the legal system in general.

Robert admits (privately) that many, and perhaps most, of his clients are guilty of some offense that is related to the crime with which they have been charged. He also claims that most of his clients have been entrapped or had evidence planted on them or in their cars or homes. Almost all of his clients have been charged with crimes that are more serious than the one(s) they actually committed.

Robert says the adversary system of justice in America encourages prosecutors to charge offenders with more serious crimes (which the prosecutors cannot prove) in order to intimidate them and force them to plead guilty (plea-bargain) to a lesser crime (which the prosecution may or may not be able to prove). By plea-bargaining to a lesser charge, criminal offenders avoid a trial and the risk of conviction on more serious charges.

Even though lawyers are aware of this ploy, they are obligated to explain the plea-bargain option to their clients, and they must agree to the plea bargain if their client, even under duress, tells them to accept the prosecution's offer. For example, if a client pleads guilty to possession of cocaine for personal use, he may get probation or a suspended sentence. If he goes to trial, he is vulnerable to fabricated evidence, perjured testimony, the zeal of a politically inspired or "end-justifies-the-means" prosecutor or law-enforcement agency—or even the whim of a distorted or vengeful jury. No one wants to wind up with a sentence of thirty years to life having been convicted of drug smuggling or distributing, exploitation of children, or other serious offense.

Because Robert is a successful criminal-defense attorney—he wins more than 85 percent of his cases—he has earned a place on the government's bad guy attorney list. Frankly, many politically inspired and crusading prosecutors and law enforcement officers would like to get Robert disbarred. Failing that, they would like to make his life so uncomfortable he'd get out of his criminal-defense practice and concentrate on noncriminal cases: business law, divorce, child custody, wills, or probate.

About a year ago Robert defended a man (I'll call him Mr. Washington) who had been arrested and charged as a drug smuggler. The assistant prosecuting attorney openly suggested that Mr. Washington was a big-time dealer they'd been "out to get" for some time. Several drug-enforcement agencies, working with the narcotics division of a major East Coast metropolitan police department, cooperated in the arrest of Mr. Washington. They handpicked Mr. Washington because they thought he was the weak link in a major cocaine distribution system that they knew was run by others, including the people who supplied Mr. Washington. The metropolitan district attorney, acting for the metropolitan police, charged Mr. Washington with importing and distributing cocaine even though their scant evidence only confirmed that he was a personal cocaine user who supported his habit by dealing to personal friends and fellow workers.

In reality, Mr. Washington was an ordinary, young, upwardly mobile professional, who casually flirted with cocaine. His eleven customers were all personal friends. Robert believes that Mr. Washington's primary incentive to sell cocaine to his friends and coworkers was his need for status—specifically, his need to be a big shot and the life of the party. Mr. Washington admits he has a strong desire to be liked and accepted and that he routinely goes out of his way to please and impress his friends and coworkers. At the time of his arrest, Mr. Washington was a junior accountant in a firm that employed more than 30 accountants. He thought of himself as the firm's token black employee. Mr. Washington was a college graduate, working to be a certified public accountant (CPA), who had no prior arrests. The inflated charges of drug smuggling and drug distribution placed a permanent cloud over his hope of becoming a CPA.

The metropolitan police, using the theory that Mr. Washington would tell his attorney, Robert, and others the truth about where he got the cocaine and to whom he sold it, obtained a court order to bug Mr. Washington's home telephone. An overzealous narcotics detective, seeing a chance to hang Robert and others on the Washington bug court order, misused the court order and installed the bug in the conference room of Robert's law office.

Obviously, Mr. Washington wasn't Robert's only client. Once the Washington bug was installed in Robert's conference room, the attorney-client privilege was effectively destroyed for all of Robert's clients. As a result, interagency cooperation between the metropolitan police unit that placed the bug and the narcotics units of several other agencies suddenly hit a new high. They discovered more than twenty new criminal relationships, the least important of which was Mr. Washington's low-level supplier and the list of casual-user friends and coworkers who were his eleven customers.

For a period of about two months, the courts approved a flurry of new telephone taps and room bugs against a wide range of persons who had not previously been suspected of anything. In each case, the probable cause offered as justification for the new court order was "an anonymous tip" or "information from a well-placed confidential informant."

Robert had been an assistant prosecuting attorney prior to entering private practice, so he quickly recognized that too many cases were being filed against individuals mentioned by his clients at attorney-client meetings held in the conference room of his law office.

Robert came to me because he thought his office was bugged. That same evening, he and I found the bug in his conference room. It was a simple but effective device, available to anyone for less than $100 from several sources, and which could be installed in ten seconds or less. The bug was a drop-in telephone pick-up, which replaced the original telephone pick-up in the mouthpiece end of the conference room telephone.

Professional-quality devices like the one we found can be activated from any telephone, anywhere in the world. The eavesdropper dials the number, then blows a dog whistle with a special pitch or uses an electronic tone generator to activate the bug before the bugged telephone has a chance to ring.

Because the bugged telephone does not ring, no one is alerted to the bug. Since the conversation is carried over the regular telephone line, there is no wiring or any radio signal to be detected. Once activated, the mouthpiece end of the existing telephone becomes an excellent microphone (especially if it is a speaker phone), and the telephone itself remains fully functional. To turn the bug off, the eavesdropper simply blows his whistle or uses his electronic tone generator again. Meanwhile, everything said inside the room can be heard and/or recorded from any other telephone.

If you value privacy and your civil rights, you'll be pleased to learn that Robert socked it to the errant narcotics detective in the end. Robert fabricated a criminal case, with the help of the supervisor of the internal affairs unit (IAU) of the same metropolitan police department that had illegally misused their court-authorized bug.

The reverse-sting worked like this: officers from internal affairs made a phony arrest of an IAU plant, who then came to Robert for his defense. Next, the plant and Robert discussed nonexistent criminal relationships between the plant and three prominent but innocent people who agreed to cooperate. Finally, in the conference room, the plant pretended to give Robert a retainer in cash, saying, "You know this is dope money. I hope it doesn't bother you that I got the money from the coke dealers in my distribution net?" Accepting dirty money is a no-no that can result in a lawyer's disbarment.

It took only twelve days for police to issue arrest warrants for Robert and the three cooperating individuals who had been identified by the internal affairs plant during the staged attorney-client conversations in the conference room. The police arrested Robert, but he was in jail less than forty-five minutes before the internal affairs supervisor arranged his release. The other three were never arrested. Internal affairs immediately quashed the arrest warrants for them.

Robert's reverse-sting operation resulted in the overturn of all of the convictions that were based in any way on information illegally gathered via the bugged telephone in his conference room, including the plea bargain accepted by Mr. Washington.

Right after Robert's reverse-sting operation I made some quick-fix modifications to the conference room.

It is interesting to note that the metropolitan police continued to consider themselves (as do many law-enforcement people) uniquely above the law. Robert tells me that, to the best of his knowledge, none of the offending officers was fired or suspended. He says that several federal drug-enforcement people transferred—to similar jobs—in other cities and that two metropolitan police officers rotated out of narcotics to other undercover assignments where, presumably, their bugging, tapping, and surveillance skills would again be put to use.

Unfortunately, reverse-sting operations are rare, and seldom are they as successful as the one done by my friend in cooperation with an honest and aggressive internal affairs unit.

* * *

Now that we've entered the law and order 1990s, telephone taps and room bugs are more and more common. Some are technically legal—as was the original, tightly restricted court-ordered bug intended for Mr. Washington's home telephone. But, as in Robert's case, many of these court-ordered bugs are misused. It is just too tempting to the law-enforcement officers who become calloused after years of installing and monitoring the usually tedious conversations obtained from room bugs and telephone taps. In practice, legal bugs and taps almost always generate accidental information. This found wealth of free facts and hot leads can't be attributed to the bug or even acknowledged as based upon bugged conversations—as in this case between Robert and his clients. As a result, information surfaces as anonymous tips or reliable information from a well-placed confidential informant.

Although bugging, tapping, and other forms of surveillance are pervasive, it is unlikely that you or I will be the subject of a court-ordered telephone tap or room bug. If we do come under surveillance by audio or optical devices, it is much more likely to be surveillance put in place by a competitor or some other enemy.

Our most serious risk comes from coincidental or accidental surveillance. At one time or another, each of us will talk to someone who is the subject of surveillance or bugging. If so, we get dealt in to whatever problem that person has because we become guilty by association with them. It is even more likely that we will come under surveillance because we're in the wrong place—a physical location that is under surveillance. We become vulnerable because what we think is a private or privileged conversation or transaction happens in a place or over a telephone (even a pay phone) that is under surveillance.

As a result, by coincidence and purely by chance, we, our conversation, and our transaction will be compromised. That chance surveillance or eavesdropping exposure makes us every bit as vulnerable as if we had been the intended target. And that vulnerability can lead to embarrassment, trouble, and frustration—for us and our friends, neighbors, and associates—whether we are innocent or not.

The Orwellian prediction of a "Big Brother" who watches over our private lives has become a reality—with a big boost from technical advances during the mid-1980s. By the year 2000, Big Brother, with the help of computer cross-indexing and universal police, will make personal freedom and independence impossible unless we learn how to protect ourselves from the invasion of our privacy now.

According to some social statisticians, 55 percent of all male Americans commit at least one felony before their thirty-fifth birthday. Prior to 1985, less than one-half of 1 percent were caught. By the year 2000 the number of persons caught—by accident or intent—is likely to skyrocket.

It may be helpful to think of safe conversation with the same degree of seriousness as, since the advent of AIDS, you now think of safe sex. Please read this book carefully. What you do to protect your privacy today will affect the rest of your life and the lives of your family, friends, associates, and all others who come in contact with you—just as they will affect your future.

CHAPTER TWO

MY FRIEND'S VULNERABLE CONFERENCE ROOM

Robert shares office space with two other attorneys. That evening, after we found the bugged telephone in his conference room, we also swept the rest of the offices.

The procedure was routine and simple enough. I placed a metronome—one of those tick-tock devices—in the conference room, then listened to an all-frequency, directional AM/FM scanner to see if the scanner picked up the regular beat from the metronome on any of the radio or television (AM, FM, VHF, UHF) frequencies it scanned. That only works, of course, when the bug you expect to find is sending a signal (transmitting).

I repeated the procedure several times over the following two weeks, each at a different time of day, always trying to activate any sleeping device with turn on probes (much like a hacker uses multiple signal sequences to open a garage door or access a restricted computer file). I was never able to locate any radio or television signals.

I also made a slow, methodical physical search for audio (listening) and optical (video) devices. I found none. I dismantled every telephone in each of the offices, then physically examined all of the light switches and electrical outlets, and each piece of electrical and electronic equipment, and every power source—in each case looking for multiplexing or hard-wired systems. Then I "patted down" every square inch of the surface area: walls, ceiling, and floor.

I routinely make a rough-scale drawing in grid form of each room I sweep. I allow about two hours for each 16′ x 16′ office. I also take apart every easy-to-assemble piece of office furniture—looking for hollow legs, false compartments in drawers, radio-activated transmitters in out-of-sight cavities, pinhole openings for through-the-wall "needlehead" microphones, camera lenses, or other intrusive devices. I personally turned upside-down every chair, table, desk, credenza, typewriter or computer stand, lamp, and all of the accouterments in the suite of offices that evening.

The following day, using powerful field glasses and my all-frequency directional scanner, I examined the exterior of Robert's law office (and the offices above, below, and to either side) from the nearest building across the street, looking and listening for an external retransmitter. Retransmitters can be driven by a feeble (low power) bug or a hard-wired crystal microphone from inside an office, through an external wall, for rebroadcast at much higher wattage to a receiver or call-forwarding device and/or recorder a mile or more away.

With the cooperation (for $50) of the night-maintenance supervisor, I also patted down the ceiling of the office below, the floor of the office above, and the common walls shared by offices on either side of Robert's suite.

Even though I searched carefully, the only audio surveillance device I was able to find was the original drop-in, tone-activated bug that had been placed by the metropolitan police narcotics unit in the mouthpiece end of the conference room telephone.

I was present when the supervisor of the internal affairs unit arrived to examine the conference room telephone. He confirmed that the bug belonged to the metropolitan police narcotics unit and that it was the one authorized by the court order for installation in Mr. Washington's home phone. He told Robert and me that no other device had been authorized, and he acknowledged that the court order *apparently* had been abused. He agreed to leave the bug in place while he and Robert conducted a reverse sting—to be acted out by Robert and police officers assigned to his internal affairs unit.

THE PROBLEM FOR ROBERT

After my exhaustive electronic and physical sweep of Robert's law offices, we still couldn't be sure the place was free of listening and/or viewing devices—or that it would stay "clean." All that my careful search had done was raise the threshold of surveillance.

If Robert's conference room or office was bugged, we could assume that any audio or optical device would have to be:

1. an expensive, professional-quality, hard-to-get, subminiature model; and,
2. hard-wired so that no broadcast signal could be detected by an all-frequency scanner such as I used; or,
3. if it transmitted, the device would have to be:
   a. a remotely controlled "on-off" system that the eavesdropper could activate, as with the bug in the telephone; and,
   b. a very low-power transmitter that would require rebroadcast from a repeater such as I searched for from the building across the street.

All of these options are very expensive and more trouble than most folks who want information are willing to take. In other words, we escalated the threshold of how much time and money it would take to bug Robert, his fellow attorneys, and/or their clients during meetings in the conference room.

Although it is unlikely that anybody would go to that much expense and effort, we couldn't be absolutely sure that they would not. Nor could we maintain the integrity of the swept condition of Robert's office space without posting a trained, full-time guard (in whom we must vest the absolute and blind trust of whatever unexpected secret might be divulged in the clean room), or by repeating the entire sweep procedure immediately before every meeting at which Robert or his client(s) might be vulnerable should attorney-client confidentiality and privilege be compromised. Resweeping obviously precludes any spontaneous confidential conferences, which eliminated the value of the conference room for more than 80 percent of its regular use. Maintaining a guard was inappropriate because it was too expensive and didn't remove vulnerability.

There were, however, some relatively simple steps Robert and his fellow lawyers could take that would make it difficult to bug or visually invade the sanctity of their conference room.

I'll tell you what I installed for Robert in the next chapter. Following the procedures I took with Robert offers a practical solution to a problem faced by all lawyers who deal with criminal defense or criminal prosecution. The information may prove useful to any businessman, accountant, investor, or labor representative who is involved with business, taxes, leveraged buy-outs, acquisitions, takeovers, mergers, or any other high-value or high-vulnerability products or data that can range from new toys for the Christmas market to new fashions for the after-ski bunny market. And, of course, it would be useful to anyone involved in activities for which prison time and/or fines are a likelihood.

WHAT'S WRONG WITH THE CONFERENCE ROOM?

We will soon deal with each of the following and many other elements that are required to create a bugproof or bug-resistant room. But, quickly, here's what's wrong with

Robert's conference room:

- It has a window.
- It has a Muzak-type sound system.
- It has a telephone.
- It has one outside and three inside walls.
- It has heavy furniture and massive art displays.
- It has an impressive conference table.
- It has a floor.
- It has a ceiling.
- It has a door.
- It has no electrical grounding or "earth" on any wall, floor, or ceiling.
- It is visually vulnerable from the outside window and from the reception room.
- It has a single-entry funneled access through the reception room.
- It is open to casual use and anonymous visitors.

A Temporary Quick Fix for Robert

As a temporary measure, we eliminated the Muzak-type sound system and the telephone, and we escalated the level of difficulty for anyone who wanted to invade Robert's privacy through the window. As an interim step, we put a five-digit push-the-button solenoid activated lock on the door. Only the attorney partners were given the five-digit combination. Therefore, no more casual visitors could get into the conference room. Furthermore, no one was allowed inside the room unless he/she was accompanied by one of the partners who, personally, had to sign each guest in (even though it was agreed that guests could be signed in by code name).

First Fix: Get Rid of the Phone and Sound System

The first and most threatening problem to the law offices and the conference room was the telephone. It had already been bugged with a sophisticated professional device that took a narcotics agent less than ten seconds to 1) surreptitiously enter the room, 2) unscrew the telephone mouthpiece, and 3) replace the standard mouthpiece with the tone-activated "on-off" device. Obviously, we had to get rid of the instrument while, hopefully, turning it (like turning any other spy) to our advantage.

I *moved* the telephone. I didn't disconnect it. I did not want the physical instrument in the conference room, but I did want to know if anybody else was trying to play "let's turn on the phone bug." For the next sixty days, during the reverse sting, the telephone instrument "lived" and was appropriately answered—in a small storage room that continued to be used to store coffee filters, legal forms, letterhead, envelopes, and other supplies essential to any effective and modern office. I connected a voice or signal-activated recorder to the phone in the hope that anyone who tried to tone-activate the bug by dialing the conference-room phone number would have their command-to-activate tone sequence and their originating number recorded. I wanted to know *if* anybody was still trying to use the bug and, if so, *who* was trying to use it!

Secondly, the conference room, as did all other rooms in the suite of offices, had a Muzak-type piped-in background sound system. Although that is convenient and "white music" has an industrial (sometimes subliminal) value, it was a mechanism that put Robert, his fellow attorneys, and their clients at risk.

I personally disconnected the music system because, in order to play music, you must have a speaker. Every speaker is potentially a low-quality microphone when it is operated in reverse. That is, a microphone has a diaphragm, which is moved by any air disturbance (modulation) caused by noise, voices, or any other sound. The microphone converts these air disturbances or modulations into electromagnetic variations in voltage, which can be carried over wire and/or transmitted by amplitude (AM) or frequency modulation (FM/television).

In normal use, a speaker takes the same electromagnetic pulses and/or modulations and converts those pulses/modulations via a diaphragm into air disturbances (patterns) that we can hear and that we interpret as speech, music, or other noise. We most often hear them, with the help of electronic aids, through bass woofers or treble tweeters.

I physically removed the speakers and the wires that connected the conference room to the central music cable in the reception room.

Caller ID

Next, I had Robert subscribe to the telephone company's newly available Caller ID service. For less than $100, Robert had the telephone company install a small box with an on-line read-out to the telephone instrument previously located in the conference room. For a fee of less than $10 a month, the Caller ID will list the telephone number from which every call is placed, whether you answer your phone or not. As a result, Robert was able to record the calling number each time someone dialed the number of the former conference room telephone.

Second Quick Fix: Neutralise the Window

The second major problem with Robert's conference room—a problem shared by most business and professional conference rooms and executive offices—is that it is impressive. Impressive most often means that the conference room, along with the senior partner's office, is located in the most attractive and prestigious space that is available and/or affordable. Impressive also means that the furniture tends to be wood and heavy, the walls are decorated with massively framed prints and paintings, and the conference table is huge and substantial. Worst of all, impressive usually means that there is at least one window.

Windows make us all vulnerable for several reasons. Even though the window may be on an upper floor, we are at risk because anyone inside the room can be seen through the window. We and our associates are vulnerable to guilt by association. None of us wants to be seen with the wrong person or in the wrong place or at the wrong time. Each of us has our little secrets, and we are all vulnerable to accidental exposure.

Like it or not, there are lots of snoopy people who get their "innocent" kicks by peeking into other offices. (Remember the character Jimmy Stewart played in *Rear Window*.) Sometimes, just being seen with an individual causes gossip, and that gossip, heard by the wrong person(s), can impact our other business and social relationships. Furthermore, there really are people who can read lips—whether in person or from videotapes created by cameras equipped with long-range or low-light-level, light-amplification telephoto lenses.

There is, of course, another major window problem. Almost all windows lack resistance to radio signals, or in other words, they fail to dampen, squelch, or inhibit radiation from radio signals. As a result, even a very low-power FM transmitter—one that doesn't have enough power to penetrate a Sheetrock partition wall between rooms in a suite of offices—will carry a signal out through the window, high above noisy traffic, to a receiver or retransmitter across an eight-lane street.

Windows also make a room vulnerable to a relatively new audio surveillance device: laser reflection-refraction. When the laser was first developed, private industry (and the government) developed laser-beam listening (surveillance) devices. (It may help to think of a laser beam as a telephone wire.) Since the late 1980s, the price for laser devices has come down to the point where they are within the budget of most professional snoopers.

Note: Currently available laser devices can be operated successfully without the need to enter the room targeted for bugging.

To oversimplify the technology: a laser beam is focused on the inside windowpane from any line-of-sight location up to three miles away. Although clarity of signal and audio fidelity is enhanced if a tiny reflective dot is placed near the center of the inside windowpane, entry into the target room is no longer essential to basic eavesdropping. Flaws in the glass or acrylic pane, scratches, dirt, and even the pigment mass in acrylic coloring will serve as adequate laser-beam reflecting surfaces. When in use, the laser light stream is interrupted as conversation (as well as other sounds or noise) causes the windowpane to move slightly and thus deflect or refract the reflected laser beam. This minute movement of the windowpane causes changes in the reflected laser beam in exactly the same way a voice causes movement in the diaphragm of the mouthpiece of a telephone or microphone.

Like the telephone diaphragm, the variations in the reflected laser beam are amplified and converted electromagnetically on the receiving end into sound. More sophisticated laser listening devices use computers to enhance and filter out ambient noises such as wind, rain, or street or airport noise. Laser devices and all other listening systems use a process that is much like the familiar home stereos that amplify and convert electromagnetic pulses and amplitude modulations, and then output them through woofers and tweeters into what we perceive as sound. It may help to think of the basic laser signal variations as the minute signals on an audio cassette that are amplified and then translated into sound(s) through a car or home stereo system.

* * *

In the following chapter you will see how I escalated the threshold of security at Robert's law office and how similar systems can make it expensive, difficult, and time consuming to bug *any* office.

It is essential to recognize that while it is possible to make a bugproof room—and this book *will* document how to do it—it is often more practical (unless you or your client is paranoid) to make a room "bug resistant."

To adequately protect yourself and/or your clients, you need only to assess and deal with actual risks. That is, you need only to estimate how much time, expense, and difficulty is likely to be used against you or your clients, and then establish a threshold that is more difficult and expensive.

A reality scale or test is appropriate. A bug-*resistant* room is usually adequate. For example, it is reasonable to expect that nobody will risk life or limb to learn if Sally is sleeping with Harry unless: there is one hell-of-a-big estate to be settled; one (or both) are religious zealots who believe they will go to some special hell if they don't get custody of the kids and rear them within their unique belief system; or someone has a compulsion to punish the "sinning" party or is a "nut case" for some other reason.

Only a bug*proof* room will protect your dialogue from the zealous nut, whether he or she is a crusading cop, prosecutor, estranged spouse, paranoid drug dealer, or wronged client or associate whose innocence or machismo has been violated.

Let's deal next with the how-to details of the quick-fix for the suite of law offices occupied by Robert and his associates.

CHAPTER THREE

A QUICK-FIX FOR WINDOW LEAKS

BASIC BUILDING BLOCKS, OR HOW TO MAKE A TRIANGULAR SANDWICH

R. Buckminster Fuller created a geometric device that enriched all of us—the geodesic dome. Fuller showed how to use a basic triangle to form a curved dome. Join enough of Fuller's "triangle blocks" and, presto, you construct a house or wall or cover a football field with a lightweight, economical, sturdy dome. In theory, Fuller's geodesic dome could cover an entire city.

Our interest in Fuller's fascinating discovery extends only to his popular system for making triangular sandwiches. Unless we want to get fancy, we don't have to concern ourselves with the more complex problems of dome curvature or the three-dimensional angles of geodesic joints. Our triangular sandwiches will be used to construct flat, rectangular, soundproof panels. We will use our panels to soundproof windows, doors, walls, ceilings, and even floors and other weight-bearing surfaces. Furthermore, since our finished surface will be flat and our triangular sandwiches separated by space, we don't even have to make our sandwiches perfect.

Sound Doesn't Travel in a Vacuum

Picture, if you will, a high-school physics class. The teacher places an alarm clock on a smooth stone slab. He winds the clock and sets the alarm to go off in two minutes.

The teacher then rubs a little grease on the open (base) edge of a science lab "bell jar." The bell jar is equipped with a small vacuum hose. The teacher then places the bell jar over the alarm clock and pumps the air out of the jar. The grease he has put on the base edge of the bell jar makes the interface between the jar and the smooth stone slab airtight.

In about thirty seconds, the little vacuum pump is laboring, and we know that nearly all of the air inside the jar has been exhausted. We have a partial vacuum. The teacher closes the valve on the vacuum hose to seal the jar and then turns off the vacuum pump.

About now we see that the alarm clock is "going off." Even though we can see the hammer strike the alarm clock bell and the alarm key unwind, *we can't hear the alarm* because there is not enough air inside the bell jar to carry the sound from the alarm clock to the glass side of the bell jar.

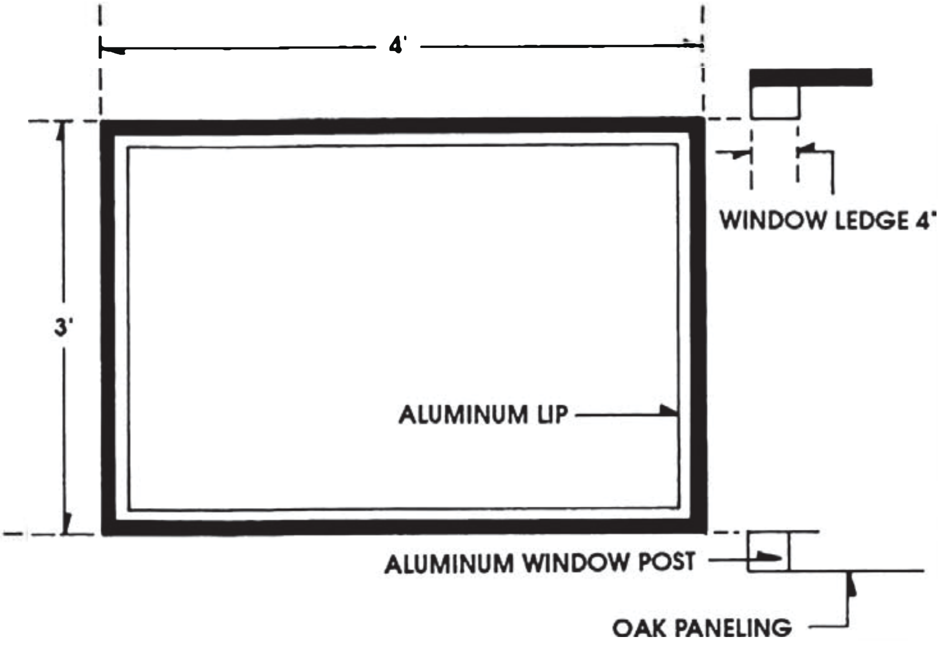
Although we can survive temporarily in a bugproof or sealed room, we cannot survive in an actual vacuum. That would be like an astronaut stepping into the vacuum of space without his space suit.

We can, however, separate ourselves from sound-sensing listening devices and human ears with a vacuum wall or a vacuum window. By itself, the vacuum wall or window won't protect us from electronic surveillance, but it will solve the problem of audio surveillance. By adding an optical blocking device and an electronic blocking device to our soundproof panels, we can keep out the visual and electronic snoops as well.

Note: The quickest, cheapest, and safest way to solve a window problem, of course, is to board up the window with ¼-inch grounded copper sheet metal, sandwiched between two soundproof acrylic panels. That blocks out the light, changes the outside appearance of the window, and is cosmetically offensive. Robert and his associates wanted to keep their window, not telegraph the modification to outside viewers, and maintain the appearance and decorum of the conference room.

Here's how we did it. For this example we'll use the specific dimensions of the single window in Robert's conference room. (See Fig. 1)

FIGURE 1
WINDOW DIMENSIONS



The window, which did not open, was 3' high and 4' wide. The lip of the aluminum frame into which the window was set covered 2"of the opening. The aluminum frame itself was flush with the outside of the building. As a result, it was recessed into a window box with an 8" ledge, all of which was inset into the exterior wall of the conference room. All of the walls of the conference room were finished in oak paneling.

Because we needed visual and electronic blocking devices, we decided to make a triple-vacuum sandwich. To achieve this, we constructed two acrylic rectangular soundproof panels and one acrylic and mesh "spacer" surface, each with an outside measurement of 3' 11" by 2' 11"—or an inch smaller than the inside dimensions of the actual window opening.

Tools and Supplies

The following tools are needed to construct a surveillance-proof window insert like the one I built for Robert's conference room.

One 4' x 5' (or larger) workbench or table.
One clean blanket, sheet, or other soft fabric.
One "fine-tooth" saw (either electric or hand).
One straightedge or metal carpenter's angle and marker.
One plywood pattern of a 9-inch equilateral triangle.
One hot-glue gun and clear (transparent) glue sticks.
One caulking gun and three tubes of silicone gel for the gun.
One electric drill.
One ¼" drill bit.
One ⅛" drill bit.
One soldering gun and solder.
One screwdriver.
One vacuum pump.

Note: Additional information about valves, vacuum pumps, hot-glue guns, caulking guns, decals, and other tools and supplies will be presented at the end of this chapter.

The following supplies will be needed:
9 each 1/16" x 3'11" x 2'11" clear acrylic sheets.
4 each 1/8" x 4'3" clear acrylic sheets.
45 feet of 1/2" or 3/4" wide polyurethane refrigerator door gasket material.
2 each air valves with shut-off locks.
2 each 3'11" x 2'11" fine mesh copper screens.
3 feet of bare copper grounding wire.
4 each 1/8" x 1" copper sheet metal screws.
1 single 3'1" x 2'11" decal.
50 each hollow cocktail straws.
2 each 1/2- to 3/4-inch thick artificial kitchen "sponges."

To build the antisurveillance window package for Robert's conference room, I purchased nine sheets of 1/16" clear acrylic precut into 3'11" x 2'11" rectangles. I later cut four of these sheets (using the plywood pattern as a tool) into triangles to be used as the "skins" of the individual equilateral (9" x 9" x 9") triangles. Four of them would be used full size as the outer skins for the finished 3'11" x 2'11" soundproof panels. The ninth panel would be used to create the electronic blocking device.

The first task is to make a small plywood tool pattern measuring 9" x 9" x 9". Since this pattern will be used to outline the 9" x 9" x 9" clear acrylic skins, it should be sanded smooth so that it will not scratch the acrylic surfaces. Although I made triangular sandwiches that were 9" x 9" x 9", it doesn't make much difference what size triangles you use to assemble the finished soundproof panels. I like to use smaller triangles if the finished panel is to be used as a floor or other weight-bearing surface and larger triangles if it is to be used for wall or ceiling areas.

To assemble equilateral triangles into a rectangular shape, you must also make four right angle triangles. I made them by dividing two of the 9" x 9" x 9" triangles in half to make four right angle triangles approximately 9 " x 4 1/2" x 7 3/8". Since the triangles do not abut and are not individually airtight, it's not essential that each one be perfect. Construction of individual triangular sandwiches is necessary to maintain the shape and prevent the collapse of the outer panel when the air is exhausted from the finished rectangular panel.

Even if you have no carpentry skills, construction is simple if you make each angle of the equilateral triangles either 60 degrees or 120 degrees from the base of the triangle. Angles of the right angle triangles to be used in the four corners of your rectangle should be 90, 120, and 150 degrees. If in doubt, remember that there are 360 degrees in a circle and all other two-dimensional shapes: rectangles, squares, triangles, and so forth.

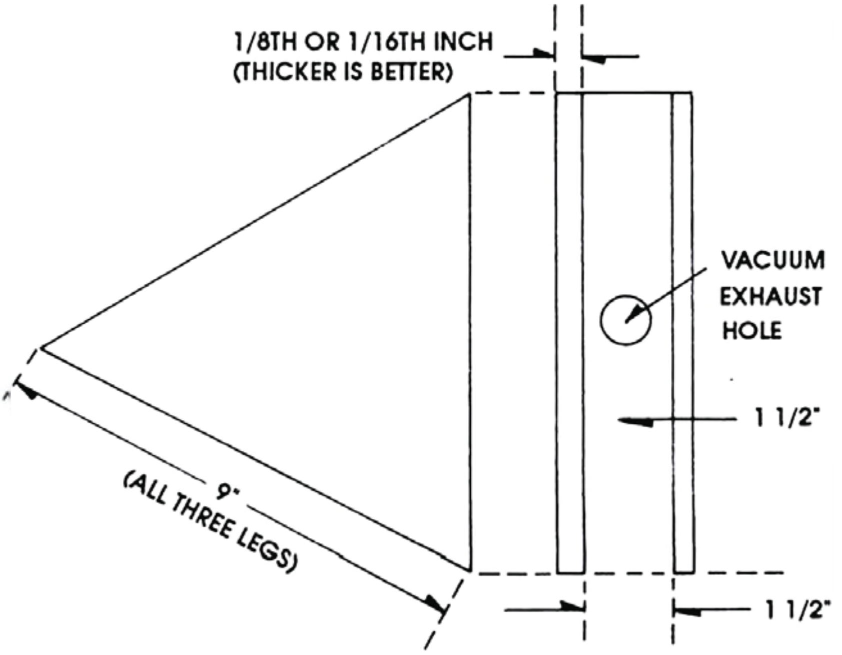
I like to space triangular sandwiches at least 1 inch, but not more than 4 inches apart, depending on whether the soundproof panel is for a wall or ceiling or for a weight-bearing surface.

To make an individual 9″ x 9″ x 9″ triangular sandwich, cut three pieces of clear ⅛-inch acrylic into boards measuring 1½″ x 9″. Cut three more pieces of ⅛-inch clear acrylic into boards measuring 1½″ x 8¾″.

Using transparent glue and a hot-glue gun, glue the flat surface of the three 9″ acrylic boards to the three 8¾″ acrylic boards to form three combined acrylic boards that are ¼″ x 1½″ x 9″ overall. One end of the ¼″ x 1½″ x 9″ board should be flush and the other end should have a ¼″ "step." (Do *not* cut the "step end" on a 45 degree angle for a "better fit." The gap created by the step will serve as a reservoir to be filled by hot glue and will help form a stronger bond.)

When the glue has set, form the three ¼″ x 9″ boards into a triangle, gluing the step end of each board to the flush end of the adjoining acrylic board to form a 9″ x 9″ x 9″ equilateral frame. Drill a ¼″ hole in the center of each leg of the assembled frame. (The holes may be drilled before assembly if you prefer.) The purpose of the ¼-inch holes and the space between the triangular sandwiches is to assure that all of the air inside the panel is exhausted when the vacuum is created. (See Figs. 2 and 3.)

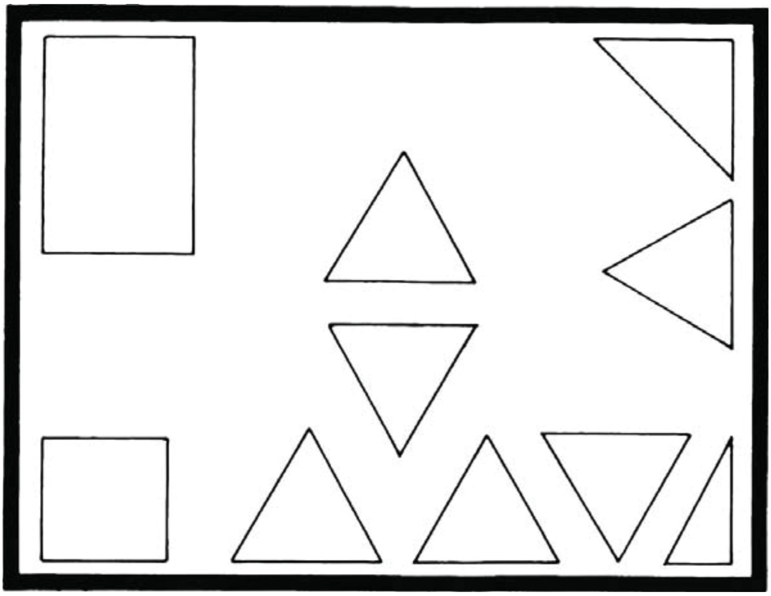
FIGURE 2
TRIANGULAR SANDWICH



Next, cut two 1/16-inch clear acrylic skins into 9" x 9" x 9" triangles. When the glue used to assemble the acrylic boards that were used to build the frame has dried, glue the 1/16" x 9" x 9" x 9" skin onto the frame. Be sure that no debris from drilling the 1/4" holes in the frame walls is trapped inside the assembled triangular sandwich.

If you wish, you may sand off any of the 1/16" skin of the triangular sandwich that extends beyond the frame edge. *Do not sand the surface area of the skin* since abrasions on the surface of the skin can be used as a focal point for laser reflection which, since the laser is optical, will not be inhibited by the vacuum that will be created inside the assembled (rectangular) soundproof panel. Store the assem-

FIGURE 3
RECTANGULAR SANDWICH



1. **Rectangular or square sandwiches can be used but are not as structurally strong as triangular sandwiches.**
2. **All sandwiches that abut a corner or wall must be bonded to the corner or wall and to the bottom skin.**
3. **Bond inside sandwiches only to the bottom skin. Arrange the inside sandwiches for best fit.**

bled triangles on edge to prevent abrasions to the skin during construction.

To build a rectangular panel frame, cut four clear acrylic boards from the ⅛-inch stock material into 1⅝" x 3'10⅝" x 2'10⅝" lengths and four acrylic boards 1⅝" x 3'10¾" x 2'10¾". (The outside dimension of the panel frame should be approximately ¼-inch smaller than the outside dimension of the panel skins.) Using clear glue sticks in your hot-glue gun, attach the flat surfaces of the four shorter acrylic frame boards to the four longer frame boards so one end is flush and the other end has a ¼-inch lip, just as you did with the shorter (9") acrylic frame boards for the triangular sandwiches.

Next, join the four ¼-inch frame boards you just assembled into a rectangle with an outside dimension of 3'10¾" x 2'10¾". Set the window panel frame aside for now.

Place a blanket or other clean, soft cloth on your workbench or table. Place the outside panel skin (3'11" x 2'11" x 1/16") on the protective blanket.

Apply the optical screening device you have selected to the inside of one of the rectangular panel skins. A wide variety of screening devices can be used. For the optical portion of the blocking device in Robert's conference room, I used a large window decal I purchased from a hobby shop that specialized in mock leaded window supplies. When in place, the decal made the window in the conference room look like colorful leaded glass. Similar decals are available from auto specialty shops that sell privacy screens for van windows and from some hardware and building supply stores that sell similar screens for home picture windows, sliding doors, or other openings.

The purpose of the decal is to make it impossible for people to see into the room through the window and to distort any snooping laser probe to the extent that any reflected laser beam will be scrambled and unreadable. (The electronic blocking device is placed elsewhere in the window defense system and will be assembled later.)

Carefully remove the rectangular skin with the decal and stand it on edge out of the way. Now place the second rectangular skin on the cloth-covered workbench or table. Place the panel frame onto the clear acrylic skin. Hot-glue the frame onto the skin. It is important that the bead of clear hot glue be as generous and uniform as possible.

Arrange the four corners (the four right triangles) so they fit against the inside corners of the frame. Hot-glue the corner right-triangle sandwiches *to both the frame and the skin*. Next, arrange the other 9" x 9" x 9" triangular sandwiches to your satisfaction on top of the skin inside the frame. Those triangular sandwiches next to the frame should touch the frame. Glue these outside triangular sandwiches *to both the frame and the skin*. Arrange the remaining triangular sandwiches so the space between them is relatively uniform. The inside sandwiches *should not touch each other*. Hot-glue them to the skin.

Note: The outside and corner triangular sandwiches that are glued to both the frame and skin will reinforce the frame when the vacuum is formed during final assembly. None of the triangular sandwiches will be glued to the decal. This ability to "creep" will allow a slight movement when the vacuum compresses and the pressure slightly distorts the outside skin on which you have applied the decal.

Use your caulking gun and silicone gel on the *outside* of the frame to seal the frame to the panel skin. The silicone gel will form an airproof seal that will not harden or become brittle. Since the atmospheric pressure will try to enter the vacuum, the heavy bead of silicone gel on the outside will be drawn into any gaps in the glue that bonds the panel frame to the panel skin.

Select the air valve of your choice and drill a hole through the inside panel skin (the skin *without* the decal) into which the valve will be seated. (Place the valve about two inches from the corner of the panel to allow space to install the panel into the window frame and to avoid the risk of the valve itself being used as a laser reflector.)

A large selection of air valves is available from gas station supply stores, school athletic and scientific suppliers, and from hobby shops. (I prefer propane hoses and valves.) Your choice will depend on the type of vacuum pump you use to exhaust the air from the finished panel. Seat the valve using appropriate bonding material. You may want to reinforce the seal with a bead of silicone gel *on the outside* of the assembled soundproof panel. Be sure that no debris from the valve hole remains inside the panel before you assemble it. (Debris trapped inside the panel or inside the triangular sandwiches will be sucked into the vacuum hose and may damage the valve or vacuum pump.)

When the valve is bonded, glue the skin to which you have applied the decal (with the decal on the inside) to the outside frame of the rectangular panel now on your workbench or table. (Do *not* glue the triangular sandwiches inside the frame to the decal.) Use the caulking gun and silicone gel to seal the skin to the frame as before.

Test the airtight quality of your glue and silicone seal by forcing smoke through the valve into the assembled panel. If any smoke escapes from the panel, reseal the flawed area with more hot glue and/or silicone gel. When you are satisfied that the finished panel is airtight, exhaust the smoke and residual air through the valve with the vacuum pump.

Close the valve before you turn off the vacuum pump, then disconnect the pump.

The outside soundproof panel is now complete and ready to be installed next to the building's original window.

Place a strip of ½" or ¾" wide polyurethane refrigerator door gasket on the aluminum window frame. Most refrigerator door gasket material comes in rolls and has adhesive backing. When the polyurethane gasket has been installed on all four sides of the aluminum window frame, put a continuous bead of hot glue on the gasket and quickly press the finished soundproof rectangular panel in place.

You may wish to use small shims on the bottom or sides of the panel to hold it in place. You may also wish to screw keepers into the side ledges of the window frame. *Do not screw anything into the soundproof panel.* Be careful not to destroy the integrity of the vacuum inside the soundproof rectangular panel which, now that it is installed, should fill the window cavity next to the original window. There should be about ½" of free space on all sides of the soundproof panel, which is separated from the aluminum window frame only by the polyurethane refrigerator door gasket to which it is glued.

When you are satisfied that the soundproof panel with the optical blocking device you have just installed is properly seated and secure, apply the ½" or ¾" wide polyurethane refrigerator door gasket material along the border of the installed panel in the same way you previously applied the gasket to the aluminum window frame.

The Electronic Blocking Device

Hot-glue one of the fine mesh copper screens to one of the 2'11" x 3'11" clear acrylic skins. Solder about 5" of bare copper wire to the bottom left and upper right corners of the copper mesh.

Turn the acrylic skin over and hot-glue the second fine mesh copper screen to the second side. Solder about 5 inches of bare copper wire to the corners of the copper screen not previously used on the first side of the skin.

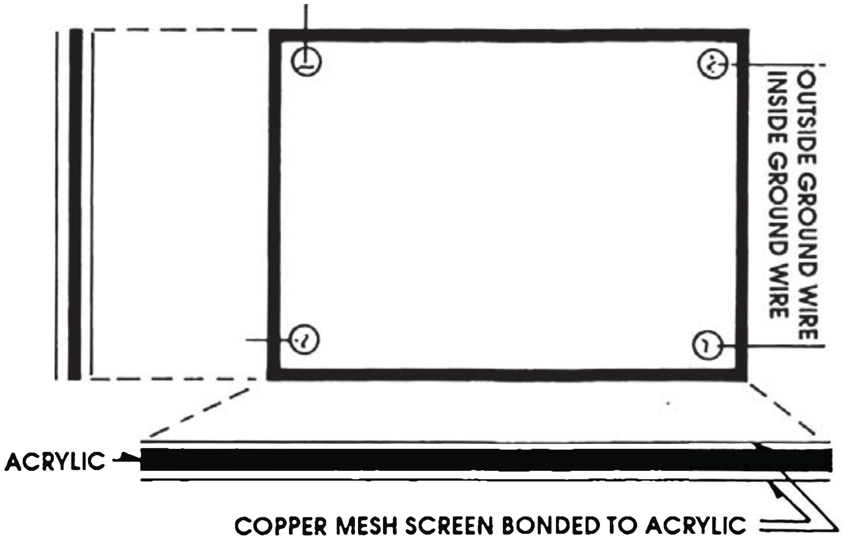
Drill four ⅛" holes in the metal frame of the window ledge about 1½ inches from the recently installed polyurethane gasket. Apply a continuous bead of hot glue to the exposed surface of the polyurethane gasket and quickly fit the electronic blocking device (the skin on which you have mounted the fine copper mesh) in place against the polyurethane gasket. Make sure all four wires are on *your side* of the device—inside the room with you—when the device is in place. (Two of the wires will have to be brought around the outside edge of the skin. The polyurethane gasket will easily compress to allow this, and no notch needs to be cut into the skin or wire mesh.)

Attach the four bare copper wires to the copper sheet metal screws and screw them into the grounding holes you previously drilled in the metal window ledge. Solder the wire to the screw heads once the screws are in place.

The Second Soundproof Panel

Now that you are an experienced builder of soundproof panels, the second will be a snap. Use the same materials and tools and the same procedure as before. You will not need to install the optical blocking device, the decal. Be

FIGURE 4
ELECTRONIC BLOCKING DEVICE



sure that the triangular sandwiches next to the rectangular frame are glued to both the frame and the skin and that they and the inside triangles are *not* glued to the second skin.

When you have constructed the second soundproof rectangular panel, test it for airtightness with smoke, then use the vacuum pump to exhaust the air. Stand the finished panel on edge, out of the way, where the clear acrylic skin will not be scarred.

Cocktail Straws and Sponge Separators

Before you install the second soundproof panel, you must separate it from the electronic blocking device that you previously installed against the polyurethane gasket mounted on the first soundproof panel.

Cut fifty transparent hollow straws (available from most cocktail waitresses for a modest tip) to make one hundred straws each about 3 inches long. Use rubber bands to tightly wrap both ends of the cut straws into bundles of about twenty-five each. You will discover that the bundled straws, because they are round and hollow, are remarkably strong and make excellent spacers with which to separate the soundproof panel that you are about to install, from the electronic blocking device that is already in place. (Only corner spacers will be needed. Since no vacuum will be formed around the electronic blocking device, no center spacers or triangular sandwiches are required.)

Cut eight circles from the artificial kitchen sponge slightly larger in diameter than the bundled cocktail straws. Cut off any "scrub" type abrasive backing from the artificial sponge circles. Hot-glue the sponge circles to each end of the four sets of bundled straws.

Once the glue that holds the sponge circles to each end of the bundled straws has cured, hot-glue one straw-and-sponge spacer near each of the four corners of the electronic blocking device.

When these are in place, apply hot glue to the exposed sponge ends of the four spacers and install the second soundproof panel. Again use shims and keepers, as necessary, to support and hold the second panel in place. You may wish to use silicone gel to help retain this second panel.

Please note that clear or transparent material (except for the screening devices) has been used throughout the construction of this system. Transparent material is essential so you can visually inspect all nonblocking elements of the device after it is installed. You or your client should visually inspect the antisurveillance system before each use to be sure no one has tampered with it.

* * *

When completed, your window—like the one I installed in Robert's conference room—will:

1. Prevent the transmission of sound through two sets of vacuum panels;
2. Effectively block all but the most sophisticated computer-enhanced optical viewing and laser-operated audio device through the decal; and,
3. Effectively block electronic radiation (radio signals) through the two earth-grounded, fine-mesh copper window screens. (The twin, grounded-copper-mesh screens will capture all but very high-powered, easy-to-detect transmitters.)

NOTES ON SOURCES OF MATERIAL

Nothing required to construct soundproof panels or blocking devices is expensive or difficult to find.

Vacuum pumps can be homemade and cheap, or they can be expensive professional models. Fig. 3 shows a professional quality vacuum pump that costs about $650. It creates a very high vacuum, does it quickly, and operates silently. (Since individual panels are easy to handle, you may want to take the finished panels to the high-vacuum professional pump or rent a professional pump for a day.) You can also make a workable vacuum pump using duct-tape and an industrial strength or shop vacuum cleaner. Or you can buy a hobby shop model of a vacuum pump for under $30. The professional model is best. The less expensive models will work for most applications.

Note: Two "soundproof" panels will do as well with a low-level of vacuum as a single panel with a high vacuum.

Air valves are avilable from a wide range of sources. The valve selection you make will depend on the type of vacuum pump you use. (Match the valve connection to the connector on the vacuum pump.) Service stations and construction contractors use a lot of air hoses. However, most "quick connect" valves operate one way only. It may be difficult to install them in your wall. Likewise, athletic departments pump up a lot of basketballs, footballs, and other sporting equipment. Any valve that will hold the pressure needed to inflate an object should also resist the atmospheric pressure (about 15 psi) that nature wants to put into the vacuum (void) created by your pump. Connecting your vacuum pump to the panel is not enough. You must have an independent turn-off—a valve mounted on the panel or on a short piece of hose to which the pump is attached.

I prefer propane hoses and valves. They are built to contain explosive gas under pressure. Most stores that carry camping or outdoor cooking supplies sell propane barbecue grills, heaters, and other appliances. They also carry the propane hoses and valves used to connect external tanks to stoves. You want the valve and a short length of hose.

Hot-glue guns and clear glue sticks are available at most hardware stores. Convenient hot-glue gun kits, including about a dozen glue sticks, cost less than $15. You can buy packages of 100 clear glue sticks for $10 or less, which is more than enough to construct any bugproof room.

Caulking guns and silicone gel tubes are also available at most hardware stores. The caulking guns cost less than $10. Tubes of silicone gel that fit into the caulking gun cost less than $5. Three of them are more than enough to construct a sophisticated bugproof room.

Fine-tooth saws are available everywhere. The finer the teeth in the saw—either electric or hand—the smoother the edge of the acrylic sheets you cut.

Acrylic sheets are available at most building materials outlets and at larger hardware stores. The thicker the acrylic sheet, the more expensive it is. For example, a half-inch thick 4 x 8 foot sheet can cost $100 or more. Thin sheets, as called for here, cost as little as $10 for a 4′ x 8′ sheet. Bonding two thin sheets makes them stronger than a single sheet of the same thickness, and it costs only a fraction as much. In addition, offsetting the sheets to make "lips," as suggested in the instructions, adds corner strength to the assembled frames.

Decals and other optical blocking devices can be found at hobby shops, auto paint shops, or some building supply outlets. There is nothing wrong with improvising a paper decal—or even a colored poster—since the decal is inside the vacuum area of the exterior soundproof panel.

Polyurethane gaskets are stocked by most hardware and appliance repair shops to replace the worn gaskets on refrigerator and freezer doors. The gaskets compress when the refrigerator or freezer door is closed. The job of the gasket is to keep the cold in and the heat out. Since for our purposes, they are used only as spacers, we don't care if they make an airtight seal or not.

Hardware, including copper screws and wire and soldering guns, is available everywhere and costs very little. If bare copper wire is not available in the electrical section of your hardware store, buy insulated *copper* wire and strip off the insulation. If you don't already have a soldering gun, they are available in most hardware and hobby stores for less than $15, including more solder than you will need.

ASSEMBLY OPTIONS AND TIPS

How you install soundproof panels and optical or electronic blocking devices is determined by your purpose and the unique conditions you must resolve. It is sometimes appropriate to modify the basic design in some way, such as:

Sealing the existing window. You can do this by caulking corners, seams, and joints with silicone gel and/or painting porous surfaces with rubberized paint.

Sealing the outside panel to the window ledge. You can do this by packing any gaps between the panel and the sides, top, and bottom window ledges with rubberized material and sealing it with silicone gel.

Clouding a panel. You may wish to deal with optical blocking by "inflating" the outside airtight panel with dense smoke—even colored smoke. If "inflated," a panel will block optical surveillance but it *will not* prevent sound transfer because there is no vacuum.

Ballooning a vacuum panel. Once you have finished a soundproof panel (created a vacuum within the panel sandwich), you have no way to know that the vacuum is intact unless you place a verification device inside the vacuum area. One simple way to do this is to place a small, high-quality, clear balloon inside the panel before you create the vacuum. Put only enough air inside the balloon to unfold it. As the vacuum outside the balloon is created, the air inside the balloon will expand, inflating the balloon. You can verify the integrity of your vacuum panel by checking the balloon: if the balloon is inflated, the vacuum is intact. If the balloon is deflated, the vacuum is spoiled. (The balloon itself may have spoiled the vacuum if the air inside the balloon has leached through the balloon wall or escaped through a faulty seal into the vacuum.)

Installing permanent vacuum hoses. You may wish to guard against the potential decay of the vacuum within your panels by permanently installing the vacuum hose to the panel and placing the valve and vacuum pump connector on the inside of the room. In this way, you can connect the vacuum pump to the hose, open the valve, and exhaust any air that may have violated the vacuum, whenever you wish. There is plenty of room between the panels and screening devices and the window ledge for the vacuum hose to pass.

YES, WE DID OVERKILL THE WINDOW

The thoroughness with which we dealt with the window is consistent with a *bugproof* room installation. As you will see, the rest of the conference room was modified to bug-*resistant* standards, commensurate with the risk level and the threshold of difficulty we wanted to establish.

We justified the window overkill because one of the three attorneys was afraid of being seen (through the window or anywhere else) with some of the street criminals he represented. He was especially afraid of having pictures taken of himself with any but prominent, headline-quality clients—of the sort that might further his budding political career. The other two attorneys were merely concerned with audio surveillance.

It doesn't matter whether fear of surveillance is based on reality, paranoia, or even some nonsecurity hidden agenda. Since the purpose of the bug-resistant room (including a bugproof window) was to give the three attorneys a feeling of comfort and security and—since it was their money—the modest amount of extra time and expense to upgrade the window was justified.

Word of the bugproof conference room soon spread among persons needing criminal defense, and the law practice grew as a result.

When in doubt, always upgrade the antisurveillance threshold by escalating the level of protection, just as we did with the conference room window. What we did may have been more than was needed, but with personal security measures, more is always a whole lot better than not quite enough to do the job.

CHAPTER FOUR

THE REST OF THE CONFERENCE ROOM

WALLS, DOOR, CEILING, FLOOR, FIXTURES, AND FURNITURE

So far in Robert's suite, we had removed the phone, disconnected the Muzak, and made the window bug-resistant, but not bugproof.

The door, walls, ceiling, floor, fixtures, and furniture had to be dealt with next, but first we had to establish some threshold definitions. A major drug dealer or contract killer would want the best possible security—a bugproof room. Robert and his associates agreed that a bug-resistant room would be good enough for them. The question then became one of threshold (i.e., *how* bug-resistant). At what threshold level of security would the associated attorneys feel comfortable?

The Door

Room access appeared to be a key element. By restricting access to the room to the three attorneys and not allowing other people to be alone in the room, there would be no unaccompanied opportunity to install a surveillance device. They also recognized that a visitor, even though accompanied by one of them, could conceivably place a bug in the room without being observed. As a result, the attorneys decided to account for each visitor who was admitted to the room to help identify anyone who might have placed a device if one were discovered later.

To track visitors, a guest book was placed on the table in the room. The date, time in, time out, and name of each guest and the accompanying attorney would be entered. Code names were to be used for each guest to avoid the risk of the visitor log being stolen or copied.

To prevent unauthorized entry to the room, a five-digit push-button electric lock was placed on the outside of the door. Only the three attorneys knew the five-digit code. To gain access, one of the three attorneys would enter the code on a ten-key pad. The correct code would activate a solenoid that would unlock the door for five seconds during which time the door could be opened from the outside. The solenoid-activated latch was electrically powered from inside the room and could be manually opened from inside the room, but not from outside. In an emergency, the door could be opened by breaking a seal on the key pad and physically removing it from the door.

The wooden door frame was replaced with one made of metal. The door itself was reinforced with metal on the inside and rehung to open outward.

Limiting access to the room also meant that all cleaning and maintenance must be performed by the three attorneys. To allow cleaning or building maintenance people into the room, especially unsupervised, would make the expense and inconvenience of the door meaningless.

The attorneys discussed the installation of a sensor-activated single-frame Super-8 movie camera to photograph each person who entered or left the conference room but decided against it because they did not want to create a film record that could be stolen, copied, or subpoenaed. Such a record would void the code-name protection offered to sensitive clients.

The Ceiling and Floor

Since the conference room was located on the fifteenth floor of a high-rise metropolitan office building, the floors (and, therefore, the ceilings) were constructed of pre-stressed concrete slabs that were bolted to steel I-beams. It seemed unlikely that the ceiling or floor of the conference room would be drilled for a surveillance device from above or below.

There was, however, a thin carpet pad and carpet on the floor and a false ceiling into which light panels had been recessed. While these out-of-sight areas offered locations in which surveillance devices could be hidden, audio or video information gathered by such a device would have had to be recorded in place or carried out of the room over hard wire or by transmitter.

To constantly guard against electronic transmission from within the conference room, I installed an all-frequency radio scanner. The electrically powered scanner was modified in two ways:

1. It was permanently "on" whenever the conference room lights were turned on; and,
2. The speaker was disconnected (so it couldn't be used as a microphone), and a flashing red light installed in its place.

Exterior wall electronic screening (described below) prevented outside radio and television transmissions from activating the scanner.

As a result, even a feeble transmission from any AM or FM signal from inside the conference room would cause the bright red light on the scanner to flash and alert everyone in the room.

To prevent multiplexing over the electrical system in the conference room, all regular electrical power to the room was disconnected. A single 120-volt 60-Hz power line was brought into the room and connected to an electrical "spike suppressor," small transformer, and electrical "filter." All electrically powered devices and lights in the conference room received power from this source.

Electrical spike suppressors are used to protect delicate electronic equipment such as computers or VCRs from power surges. Power filters are used to "clean" the quality of electrical power that operates similar delicate equipment. The small transformer, often built into either the spike suppressor or filter, further controls and insulates delicate equipment from the inconsistent peaks and valleys of commercial and industrial power supplies.

Multiplexing—the use of regular electrical lines to transmit signals—is inhibited by filters and surge suppressors. Multiplexing will not pass through a transformer.

Thus, even though it was possible to hide a surveillance device inside the conference room, it was no longer possible to transmit the information without activating the all-frequency scanner, or to multiplex it over the original hard-wired electrical system.

Walls

Since radio and television signals could enter the conference room through the exterior wall in which the only window (now protected) was located, it was necessary to remove the oak paneling and cover the rest of the bare exterior wall with the same type of grounded copper mesh used as a blocking device in the window.

Once the all-frequency scanner confirmed that no signal radiation was entering the room from the outside, the oak paneling was reinstalled. Since ambient radio and television station broadcast signals are much more powerful than signals broadcast by any surveillance device, we were confident that the conference room was secure from electronic snoops. Unfortunately, that did not protect the room from through-the-wall devices on the other (inside) walls.

We tested the soundproof quality of the room by placing a Walkman-type "blaster" radio in the room, shutting the door, and trying to hear it with the help of a stethoscope. Once more, with the clandestine help of the night maintenance supervisor, we checked the one conference room wall that was common with a neighboring office. We determined that the base vibrations of the blaster radio could be heard (and felt) but that normal conversation was impossible to detect.

The two inside walls shared by other rooms in the law office were much less soundproof. To further dampen the natural sound resistance of these three walls, we did the following:

1. We removed the oak paneling and glued a ½" thick layer of "bubble" packaging material—the plastic encased material that uses thousands of little air bubbles to cushion and protect delicate equipment during shipment—to the wall.
2. We covered this material with 4′ x 8′ sheets of ¹⁄₁₆" clear acrylic skin.
3. We glued a second ½" thick layer of bubble packaging material over the layer of acrylic skin.
4. We reinstalled the oak paneling.

We completed the work in less than five hours and tested the sound-dampening quality with our blaster radio and stethoscope again. Although we could feel some of the bass notes, we could no longer tell that the sound we felt was created by loud music.

Fixtures and Furniture

We removed the heavy wood table and chairs and replaced them with a modern clear-glass conference table and matching clear acrylic designer chairs. We also removed the comfortable (but vulnerable) overstuffed leather couch and the two oak end tables and brass lamps.

It is essential to be able to visually check fixtures and furniture for surveillance devices. (It's hard to hide a small tape recorder in a glass table or transparent acrylic chair.)

PERSONAL SURVEILLANCE DEVICES

Although the conference room itself was now adequately secure from audio and video surveillance devices, conversations inside the room were still vulnerable to recording devices hidden in purses, briefcases, or clothing or taped to the skin of visitors.

Unfortunately, the only way to avoid a carry-in device is to forbid purses, briefcases, and other packages; then strip-search each person and replace his or her street clothing (including shoes, bra, panties, watches, earrings, and other items) with presearched "clean" garments—inside the conference room, while you watch—and remove everything else from the room, including your own clothing, to be sure nobody has "planted" a miniature recorder in your own pocket!

Note: Although the all-frequency scanner will warn the occupants if a guest is carrying a transmitter, it will not detect a hidden recorder. It is generally a good idea to keep purses and briefcases outside the bug-resistant room and to furnish any pencils, pads, calculators, or other supplies that may be needed.

Since the clients represented by the law firm wanted to protect their secrets as much as the attorneys, carry-in tape recorders were not considered to be a serious risk.

These estimates and conclusions were appropriate for Robert and his associates because they were attorneys. Nearly all of the "secrets" divulged in the conference room were told to them by their clients. As a result, there was little motive for a client to tape-record his own secret. Robert and his associates were only vulnerable if they, as attorneys, conspired with a client to break the law, offered illegal advice, or acknowledged that funds received by them came from criminal activity.

* * *

Now that you know how to make a bug-resistant room, let's examine the difference between rooms that are merely bug-resistant and those that are bugproof. We'll see how to build a room that cannot be bugged *while you're using it* or while you're away *without your knowing it*.

CHAPTER FIVE

THE "PERFECT" BUGPROOF ROOM

EARTHING, OR MR. FARADAY'S CAGE

For centuries scientists who work with delicate instruments have been plagued by stray electrical fields. The development of radio and other radiating devices has added greatly to such natural sources of electrical disturbance as sun spots, electrical storms, and so on.

In the 1800s, a scientist named Michael Faraday concluded that he could protect his experiments and his equipment from the influence of these ambient electrical variations by *earthing* the space in which his equipment and experiments were conducted. This earthed, or grounded, space became known as the "Faraday Cage."

Here is the essence of the Faraday "field-free" or "zero-field" theory:

The crust of the Earth is mostly made up of material that is moderately conductive to electricity. In addition, water contained in the ground includes salts and, as a result, forms an electrolyte that conducts electricity even better than the surface. This combination lets electric currents pass from one point to others, through the soil, whenever there are different voltages at different points on the surface of the Earth.

Since this happens at about the speed of light (approximately 186,000 miles per second), it means that any differences in voltage will be instantly equalized. To explain these discoveries and make them useful measurements, names needed to be invented. To do so, scientists assigned the value "zero" to the Earth itself so that all other measured values would be more (+) or less (−) volts, etc.

For our purposes, this means that electrical equipment that is "connected" to the Earth is "grounded" or "earthed" and, as a result, takes on the same value (zero) as the Earth itself. That is, once an object with a potential to carry electrical current is grounded, no difference in potential electrical voltage can exist within it. From a day-to-day practical point of view, grounding an electrical object protects us against electrical shock. That's why modern electrical outlets always have a third post—or "ground." (If you touch a live or charged metal object that is not grounded you will get a shock.) Likewise, radio transmissions—which also are a form of electromagnetic energy—are instantly absorbed into the Earth through the grounded metal screens or plates with which they make contact.

The theory of grounding is key to building a bugproof room. (We used the grounding theory when we constructed an electronic blocking device by installing fine copper mesh screens over the conference room window—and grounding the screens.) Electronic fields on both sides of the grounded screens will be instantly absorbed (converted to zero potential) if they come in contact with the screen mesh or the electromagnetic fields between the wires of the mesh.

Note: Radio transmission inside a carefully grounded room cannot pass through the zero field created by the grounded screen.

While the scientist wants to protect his instruments and experiments from outside electrical influences, we need to keep hostile surveillance transmissions inside the room from getting out. Fortunately for us, the Faraday Cage, which was designed by scientists to keep ambient electrical fields out, works equally well to keep the radio signals transmitted by bugs from escaping.

HOW ELECTRONICALLY "SAFE" ROOMS WORK

If the floor, ceiling, walls, windows, and doors of a room are surrounded by wire netting (or metal plates) and all of them are connected together and then grounded, the room takes on the same potential electrical value as the Earth, zero. Since there can be no potential difference between any one point in the room (zero) and any other point in the room (also zero), no electric field (no radio signal) can be broadcast from inside the room.

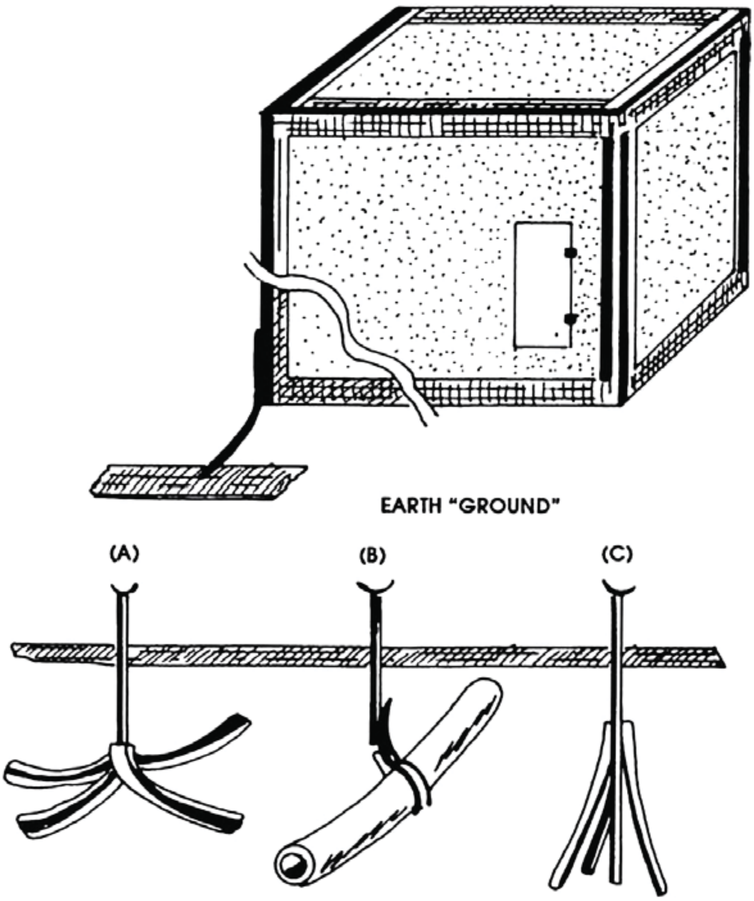
The better the grounding, the safer the room from surveillance transmitters. To be perfect, a bugproof room must have its own ground. The best of the available practical grounds is a low-resistance (thick or heavy gauge) copper wire that is directly connected between the Faraday Cage (the metal mesh screens that surround the room) and metallic water supply pipes (which themselves are connected to other water pipes, some of which are burioed deep underground). See Fig. 5.

Meetings in a Vacuum

Remember the example of the high-school science teacher who placed a spring-wound alarm clock in a bell jar, then vacuumed the air from the jar? The alarm clock sounded, but the students who witnessed the experiment couldn't hear the alarm because there was no air to carry the sound from the clock to the surface of the jar.

Obviously, we can't live in a vacuum. Our blood pressure would make our body explode, and we couldn't breathe—to mention just two problems. And, of course, we couldn't

FIGURE 5
FARADAY CAGE AND GROUNDS



A Faraday Cage is any field-free space—whether one-foot square or room size. Protection from surveillance is created by lining the walls, ceiling, floor, and door with copper mesh screens, grounding all screens together, and the entire room to "earth" via (A) earth electrode strips, (B) metal water pipes, or (C) earth electrode rods.

carry on a conversation. Carrying on a secure conversation is, after all, the purpose of a bugproof room, isn't it?

But what if we had two bell jars, one larger than the other. And, what if we were inside the smaller bell jar when the air was vacuumed out of the larger bell jar! We'd be okay, at least until we ran out of air, because the vacuum would only remove the air between the two bell jars.

That is the principle behind the soundproof vacuum panels we installed in my friend's conference room window.

A Room, within a Room, within a Room

Room 1: The outside room is an empty shell, It is the container within which we plan to construct a safe place—a room that can't be bugged while we're using it. Select the place in which you construct your bugproof room carefully. We'll discuss this problem in more detail later.

Room 2: The inside room is the Faraday Cage—the "zero field" room created by covering the walls, floor, and ceiling of the empty shell with fine metal mesh screens or plates and grounding the plates directly to metal water supply pipes.

If you recall the process we used to create the electronic blocking device for the conference room window, you already have almost all the information you need to ground an entire room (create a room-size Faraday Cage).

Caution: While it is true that a Faraday Cage will prevent radio signals from escaping, persons who wish to bug your conversations will use exceptional means to attempt to violate the integrity of your safe cage. This is most often done by probing the cage. That is, a heavily insulated antenna with a noninsulated tip is inserted between the wires of your mesh screen. The tip of the antenna—which is inside the Faraday Cage—will receive the signal and carry it through the insulated antenna shaft outside the cage where it can be recorded or transmitted.

You can protect yourself from this risk in three ways.

First, you will be inside the soundproof room (Room 3, facing page). Second, install the grounded metal screens in a special way. Third, use special electric fans. It is best to use all three safeguards.

First, before you install the grounded metal screens on the walls, ceiling, floor, and door(s) of your room, it is helpful to paint all surfaces with a white rubber-based paint. The white paint will help you see any probe holes or devices that have been placed in the finished room. The paint by itself will not deter surveillance, but it will help later when you illuminate the transparent room with outside lights.

Install all grounded metal screens (except the floor screen) on brackets that stand out at least one inch from the wall or other surface you are covering. In this way, any antenna or other probe that is inserted into the room will be easier to detect since it must pass through the outer wall, the inch of open space between the wall and Faraday screen, and at least one additional inch inside the screen.

Faraday Cage doors: Since you and your associate(s) must enter and leave the Faraday Cage, you must include at least one door. When a door to the room is open, the shielded portion of the room continues to be protected *but radio signals will pass through the open door*. (Even though signals passing through an opening, such as a door, in a Faraday Cage will be distorted, they can be received and unscrambled.)

To be secure, the door itself must be covered with the same screening material as the rest of the room. (The screen on the door should overlap the screen that covers the door frame so there is no unprotected "gap" through which a radio signal might escape.)

The door must be grounded to the rest of the room. You can do this easily by attaching two flexible cables (such as the cables that connect a car battery to ground) one near the top and one near the bottom of the door, on the hinged side. Connect one end of each cable to the grounded screen on the wall and the other end to the screen mounted on the door. Be sure there is enough slack in the cables to allow the door to be opened and closed without stressing the connection at either end. (It is a good idea to solder each cable to the screens at both ends.)

Note: It is essential that the door(s) to the Faraday Cage (zero field room) be closed and the screen covering on the door(s) properly grounded when the room is in use.

Room 3: The third room is the soundproof room we're about to design. When you and your associates are inside this room and the door is sealed, nobody will be able to hear what you say. You already have most of the information you will need to build Room 3.

Soundproofing an Entire Room

Chapter 3 explained how to create soundproof rectangular panels to fit a window. That same procedure works equally well for building soundproof walls.

The main difference between a bugproof room and a bug-resistant room is that in a bugproof room, all walls, ceiling, floor, and door(s) must be sealed against electronic and sound surveillance. Making an entire room soundproof involves making a soundproof door, air-buffeting the external walls, and constructing an acrylic floor that will support the weight of people, chairs, and a table.

Since the inner chamber (Room 3) of our bugproof room will be airtight when the door is shut, we must limit the number of people (air-breathing bodies) who are inside the room and how long any or all of these bodies stay inside the room. My physician gave me the following formula:

> Air at sea level is approximately 20 percent oxygen. A normal adult, seated and calm, will consume about 400 cubic centimeters with every breath. Based on normal rates of breathing and oxygen content, it takes about 4 cubic feet of space per person per minute to function. However, if the discussion is tense or any of the per-

> sons in the room becomes angry or excited, *each person can consume the oxygen from as much as 8 cubic feet of air each minute.*

Because the inner chamber is sealed and the air is not replaced while the door is closed, the size of the room will dictate the number of people who can be inside the room and how long they can stay. It is best to allow at least 5 cubic feet of space for each person per minute. That is, allow an empty air space measuring 5′ x 1′ x 1′ for each person for every minute the meeting will last. Keep in mind that bodies and furniture inside the room will displace some of the air. This displaced air must be subtracted from the total cubic foot volume of the room.

Warning: If the oxygen in the air is exhausted, everyone in the closed room will get dizzy and possibly pass out. If they only get dizzy, they will leave the meeting angry and with a headache caused by oxygen starvation. If they pass out, you and they will not be able to open the door and get out of the room, and you and they could die.

Some material may be toxic or oxygen absorbing or contaminating. Depending on the product you buy, who made it, when it was made, how long it has been in storage, or the shared environment in which it was stored (or used), it is possible that the acrylic, bonding glue, silicone gel, and other materials may either deplete or contaminate the oxygen content of a closed room. Likewise, there is less air (and oxygen) on hot days, at high altitudes, in a polluted city, and under other circumstances.

The Importance of Being Canary-Wary

Miners learned long ago that the respiratory systems of canaries and other small birds are more sensitive to harmful gases and lack of oxygen than the human system. That's why canaries were often taken into mine shafts. If the canary got sick or died, the miners ran for safety.

While an outside timing device will be suggested later, such devices can fail or go unnoticed in the heat of debate. Canaries never fail. If you are going to build a bugproof room, you also need to buy or build a transparent nonmetallic bird cage and a (chirping) canary or two. The bird cage must be transparent so it can't be bugged.

Put your canary in your cage and take it with you into the inner chamber. If the canary gets sick—break the seal on the door and get out of the room! A sick canary means somebody has gassed your room or you've run dangerously low on oxygen.

Always test the closed room with a canary before you expose people. It may not be nice to make a canary sick or kill it, but if your room goes bad, your business associates and clients will never forgive you—if they survive! And if you aren't in the room with them and they survive, they'll think you tried to kill them. That is why there is only one latch and it is on the inside. No one wants to be locked inside a transparent airtight room—especially when he can watch the person who locked him in smile as he slowly suffocates. (Lock the Faraday Cage from the inside and don't leave objects that can be used to block the door lying around.)

How Big a Room?

Since the purpose of the room is to hold secret conversations, it is important to put the horse before the cart and first determine how many people will meet and how long they will be inside the room in order to determine the appropriate room size.

The chart below may be useful as an information guide to help you estimate the size of a room you may need.

Space for a 5-10 Minute Meeting

Persons	Minimum Air Needed	Minimum Room Size
2 persons	100 cu. ft.	6 x 6 x 5 feet
3 persons	175 cu. ft.	6 x 6 x 8 feet
4 persons	350 cu. ft.	6 x 8 x 8 feet
5 persons	475 cu. ft.	6 x 8 x 10 feet
6 persons	650 cu. ft.	6 x 10 x 12 feet

This chart is furnished as an information guide only. You must carefully calculate the size of any room you design or build based on the specific conditions at your location. If you are not scientifically qualified to estimate necessary air quality, consumption data, and available volumes, consult someone who is both professionally qualified and familiar with local conditions. Local conditions include, but are not limited to, altitude, temperature, and air quality. When in doubt make the room larger, the number of people fewer, and the time inside shorter.

Structural considerations make it difficult and expensive to construct inner soundproof chambers larger than 10 feet wide by 12′ long by 8′ high. In practice, the inside height tends to be 6′6″.

Plan meetings to last ten minutes or less. If a meeting lasts longer than ten minutes, it *must* be interrupted by five-minute breaks every seven to ten minutes. During breaks, everyone must leave the room so the stale air inside the room can be exhausted and replaced by fresh air. If more persons are inside the room than the size allows, the time must be reduced.

Making It "Perfectly" Clear

Every component of the soundproof inner chamber—Room 3—must be constructed of clear acrylic sheets. Every piece of furniture must be constructed by you of clear acrylic sheets or assembled by you from clear glass, plastic or acrylic material: glass table legs and plastic or acrylic chairs and table top. If you purchase a finished chair or table, select one that is completely transparent. If it isn't, take it apart and replace as much of the opaque (nontransparent) material as possible. If any object you buy uses metal screws or parts, replace as many of them as possible with clear acrylic screws or bond the components together with transparent glue. *Remember:* it is difficult to hide a transmitter or recorder in a transparent table or chair.

Thus, even though someone may violate your grounded Faraday screen with an insulated antenna probe, it won't do them any good if there is no place to hide a transmitter inside the soundproof inner chamber.

Build the Floor First. Everything Rests on It

Years ago the airline industry had an expensive problem with the aisles of their new jetliners. Passengers kept punching holes in the aisles! It took millions of dollars to replace the original aisles and resolve the problem.

The original aircraft aisles and seating area were built of lightweight "honeycombed" metal—much like the walls of corrugated cardboard boxes. Thousands of these short vertical corrugated metal walls were bonded together to make a lightweight honeycombed deck. The deck was more than strong enough to support the heaviest passenger or food cart. But the problem didn't come from 500-pound Japanese wrestlers or food and booze carts. It came from 102-pound women in high-heeled shoes.

The weight per square inch of a 102-pound woman when she walks on a shoe with a ¼" spike heel can be 1,632 pounds per square inch. So, even though the honeycombed decks of the jetliner could handle a 1,000-pound food cart, they broke under the pressure of petite women in spike-heeled shoes.

The soundproof floor of the inner chamber won't be built of honeycomb metal, of course, but it is vulnerable to cracks. Even though the acrylic skin probably won't break or shatter, it might crack under stress and release the vacuum. No vacuum—no bugproof room.

As a result, you're going to have to spend some extra money on the floor portion of the bugproof room. Even though you construct the vacuum floor panels much like the ones we made for the conference room window, you will have to use smaller triangular sandwiches, use more of them, place them closer together, and cover them with two layers of ¼" acrylic skin when you assemble the floor.

This will take more time and a little more material, but it won't cost much more since the materials are the same (1⁄16" and ⅛" acrylic) as we used to make the conference room window. The ceiling and walls are constructed entirely from this 1⁄16" and ⅛" material.

Only the two skins of the floor, the footings, and the door will require ¼" thick acrylic. One-fourth-inch thick 4' x 8' sheets of clear acrylic cost as much as $100.

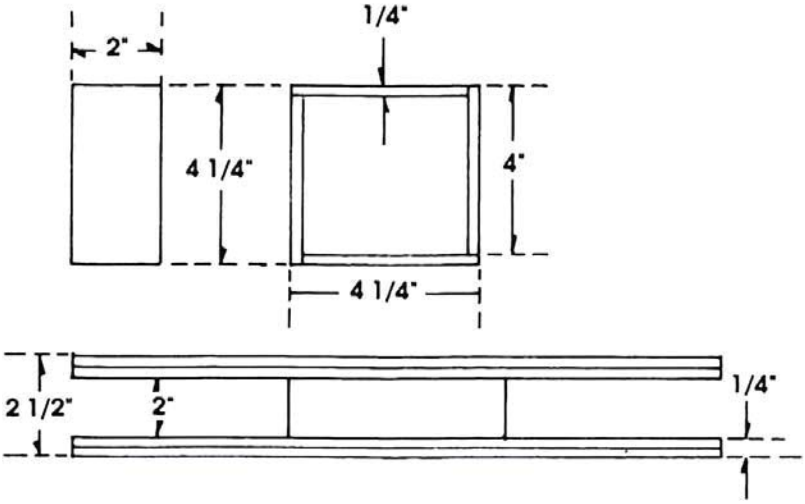
You will need to bond two of these ¼" thick sheets together to make each outside (½" thick) skin for the floor. Except for the added thickness of these outside skins, the floor panels are the same as the panels for walls and ceiling.

You will also need floor footings to support the bottom of the deck about 2 inches above the mesh screen that covers the painted floor of the room. (The mesh screen on the floor does *not* need to be separated from the floor by brackets as it is on the ceiling and walls.)

Each footing can be prefabricated by bonding 4" x 4" wide squares of ¼" acrylic to make a hollow square 2 inches high. The assembled hollow square should then be capped at both open ends by a 12" x 12" x ¼" acrylic square. (Glue the 2" high 4" x 4" square to the center of the 12" x 12" square. See Fig. 6.) Each square is glued to the metal mesh on the floor *but not* to the acrylic floor that will be placed on top of the footing.

The shifting weight caused by the movement of persons in the room will stress the deck and cause the floor to creep slightly. It is important that the bottom surface of the acrylic floor be able to adjust without transferring the stress to the

FIGURE 6
FOOTING SUPPORTS



footing and possibly breaking the footing or cracking the floor skin which, in turn, might void the vacuum inside the floor panel.

Six to eight footings should be adequate for most bug-proof rooms. Extra footings will make a more solid deck, generate a more secure image, and reduce the chance that the floor will warp or crack.

You may wish to cover the inside floor skin on which you walk with 1/16" thick clear acrylic sheets. If you do, don't bond the sheets to the 1/2" thick acrylic inside panel skin you constructed. The 1/16" sheets will act as a carpet to protect the much more expensive stress-bearing inside panel skin from abrasions and maintain the transparency required to check for newly planted bugs or surveillance gadgets.

An Airtight Hatch

The door and door frame are easy to make. The actual door doesn't have to be large if you place the transparent chairs and table inside the room before the final wall is installed. You probably won't have enough clearance to bring furniture into the room through the ceiling, which can't be installed until the first three walls are in place.

The overall height of ceilings in most rooms is eight feet. You will lose the use of about six inches of space next to the floor of the room because of the wire mesh, footings, and the deck of the inner chamber. You will also lose about six inches from the ceiling to brackets, the Faraday mesh screen that hangs from them, and the soundproof ceiling panel of the inner chamber. As a result, you will have about seven feet of vertical space available.

You should plan to make the inside height of your inner chamber about 6'6". This will allow comfortable head room and give you a safety margin of air volume. Since the height of the wall panels will be uniform, you can have the clear acrylic sheets (for the walls) precut to 6'6".

Assemble the soundproof wall panels exactly as we did for the conference room window panels. Since the soundproof room will be longer and wider than four feet, you must overlap the ⅛-inch outside skins, as the panels are built to assure a proper vacuum seal.

Likewise, when two or more panels are placed side by side, the abutting sides must be included in the vacuum. Not only must the common panel edges be glued together where they join and the joints caulked with silicone gel on both outer surfaces of the panels, an additional 1/16" x 12" x 6'6" strip must be glued over both sides of the seam between the panels. It is prudent to caulk the edges of these carefully glued seam overlay skins with silicone gel.

Note: You must decide whether or not to make each wall, floor, and ceiling panel a self-contained vacuum. If each panel is to be separate, each must have its own valve. Not only is that more work and expense, it means there can be no vacuum between the panels. It is more effective to make each wall, ceiling, or floor a contiguous unit with a single vacuum valve. Thus, before joining panels to form a common wall, you must drill matching airway passages between panels that abut and be sure the skin-strips that cover the seams between panel sections are airtight. (Please review the procedure for installing valves and creating panel vacuums in Chapter 3.)

The Port of Entry

The door should be placed close to the corner of a side and end wall, with the door frame built into the side wall and the door hinged from the outside onto the wall at least six inches from the end.

Although you can cut the door opening from a finished side panel, it is easier to allow for the door when one of the side panels is constructed. The door should be at least 2 ½' wide and 4 ½' high. The bottom of the door opening should be at least 6 inches above the bottom of the panel, and the top of the opening should be at least 6 inches below the top of the panel. (Picture the door "hatches" that separate compartments on a navy ship.) To enter or leave the inner chamber everyone will have to step over a 6" threshold and duck their heads to pass through the door.

Square corners on the door frame and the door work just as well as fancy curved doors and are a lot easier to build. You already know how to build the panel. The only difference in the panel that contains the door frame is that the three unhinged surfaces must be at a slight angle so the door will seat properly. A matching angle is also needed on the three unhinged sides of the door itself. (See Fig. 6.)

Whatever the size of the door frame you design, the edge inside the room should be about three inches smaller than the exterior dimensions. Likewise, the complementing dimensions of the door should be about 3 ½ inches smaller than the door frame into which it will seat when closed. To be complementing, the smaller dimension on the door should be on the inside of the room.

In addition, a ¼" thick x 2" wide acrylic strip should be bonded to all four sides of the door frame to form a lip on the *inside of the room.* The purpose of this lip is to overlap the door opening by at least 1 inch.

A transparent polyurethane gasket (similar to the refrigerator door seals used in the conference room window) should be mounted on the door side of this lip so that the door, when closed, will compress the polyurethane gasket and create a seal. Additional polyurethane seals may be used elsewhere, as needed, to assure the tightest possible interface between the door and the door frame. Keep in mind the need to inspect everything by seeing through objects, including polyurethane gaskets.

As a further precaution, you may wish to use petroleum jelly on the polyurethane to make the same kind of airtight seal that was demonstrated in the science teacher bell jar illustration. Even though the polyurethane seal with a thick coat of petroleum jelly does not create a vacuum between the door and frame, it will make the interface airtight and sound absorbent. That is a very effective way to make the room soundproof when the door is closed.

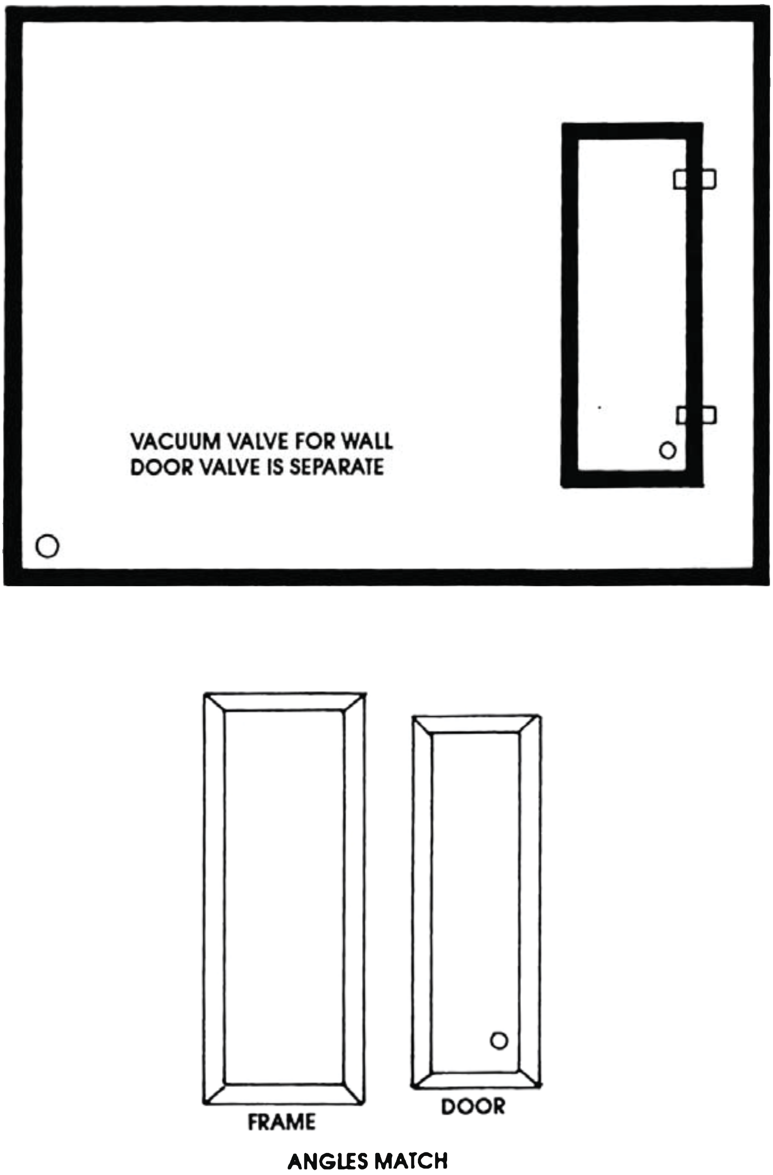
Hanging the door and latching it when closed is best accomplished if you can find transparent hinges. *Use no screws* to attach the hinges or latching device directly to walls or doors. The only surface available into which you can screw a hinge is a vacuum panel. As a result, the screw will jeopardize the integrity of the vacuum and may void the soundproof wall or soundproof door panel.

Glue works wonders. If you can't get the glue to hold the weight of the door, try to use clear acrylic screws, and then only screw the hinges onto a separate ½" thick strip of acrylic, which you will bond to the outside of the panel and door with glue. If you cannot find transparent acrylic hinges or screws, use aluminum products. Since they are mounted on the outside of the soundproof wall and door, they will not transfer conversation from inside the room. (See Fig. 7.)

Closing the Door Behind You

Latching the door shut is like closing the door of a horse barn. You may be able to find a ready-made transparent

FIGURE 7
INNER-CHAMBER DOOR AND FRAME



latching device. If not, you can design one similar to the following:

Make two U-shaped latch keepers:

Part A: Bond two ¼" x 2" x 3" strips together to make a ½" x 2" x 3" strip. Make six of these strips.

Part B: Bond two ¼" x 2" x 1" strips together to make a ½" x 2" x 1" strip. Make two of these strips.

Glue two Part A units to one Part B unit to form each square U-shaped latch keeper.

Glue one latch keeper near each side of the inside of the door, at the same height, so that the end of each latch keeper is at least 2 inches away from the edge of the door and does not interfere with the movement of the door when it is opened or closed. Mount the latch keepers so the closed end (bottom of the "U") is down.

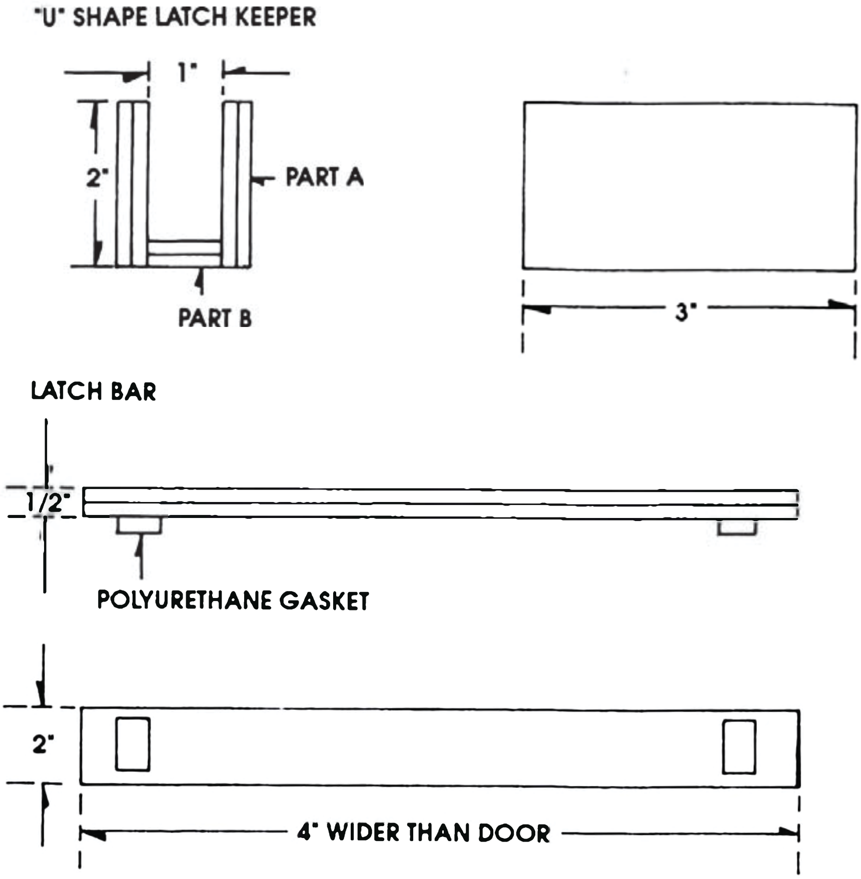
Make a latch bar: Measure the door frame (opening) and make the length of the latch bar at least 4 inches longer. The end of the latch bar on the hinge (end wall) side of the door may be less than 4 inches but must be at least one inch beyond the door frame.

Cut two ¼" x 2" strips of clear acrylic to the length you just measured. Glue the two strips together to form the basic ½" thick latching bar. Now glue a 2" strip of polyurethane gasket across each end of the latching bar. The polyurethane gasket will prevent the latching bar from scratching the door frame and will keep the door tightly shut.

Door closing fixture: To close the door from the inside, you will need a handle or other fixture to pull the door shut. Any transparent fixture will work. *Do not use screws* to mount it to the inside of the door. If you can't find a glass or clear plastic or acrylic door handle at your hardware store, you can make one by stacking four different sized ¼" thick rectangular acrylic pieces together and bonding them so the smallest piece is glued to the inside of the door and the largest piece is farthest from the door. That is, glue a 2" x 2" x ¼" piece to the door, a 3" x 3" x ¼" piece to the first piece, a 4" x 4" x ¼" piece to the second piece, and so on.

To close the door from the inside, pull on the door handle until the door is properly closed, then insert the latching bar into the latch keepers mounted on the inside of the door. When you insert the latching bar into the latch keepers be sure the polyurethane gaskets are away from you and toward the door.

FIGURE 8
DOOR LATCH KEEPERS AND BAR



MAINTAINING A STATE OF EMPTINESS

The door, each of the four walls, the ceiling, and the floor of the soundproof room all contain a vacuum. Each must have its own valve, and each must have its vacuum formed and sealed separately.

Even so, there is some porosity in nearly everything, and, over time, air will find its way into the vacuum through the silicone gel and glue and possibly through flaws in the acrylic skin itself.

It may be desirable to spend $600 or so to buy a professional vacuum pump because you have a large volume of air to exhaust and you must create as high a vacuum as possible. While duct tape on a vacuum cleaner may create a satisfactory vacuum in a 3′ x 4′ double window panel, it won't pull enough vacuum to make a 6′ x 10′ x 12′ single wall completely soundproof.

Although a way to test for vacuum integrity (without using balloons) will be presented next, it is a good idea to upgrade the vacuum within the door, walls, ceiling, and floor once a month whether you observe signs (sounds) of vacuum decay or not. Owning or renting a professional vacuum pump will be money well spent. (See Fig. 8.)

Lights, Fans, and Other Gadgets

You will need three fans. One should be at least 18 inches in diameter and mounted on a stand. Each fan must have three or more blades. (I bought a good one with three speeds for less than $25.) Even though you will use the first fan to recycle the air inside the soundproof chamber before and after each five to ten minute use, it also serves to cool the room and will be used to create a random noise. This artificial wind-noise has several uses. Among others, it helps cover any accidental comments made when the door to the soundproof chamber is open.

To make the noise unpredictably random, use a carpenter's file to notch the front of one of the blades three times. Notch the back of the blade next to it two times. Do not notch any other blades.

Place this fan facing the door so that it points through the door at an angle and pushes air through the door toward the center of the room. This first fan should be about three feet from the door. *Turn this fan on high and leave it on the entire time you are inside the Faraday Cage,* whether you are inside the soundproof inner chamber of not or whether the door to the inner chamber is open or closed.

The second and third fans should be different makes or models and should have a different number of blades. Each should have a fan diameter of at least twenty-four inches. Notch the blades of the second fan, but use more or fewer notches on the blades you intentionally damage and always leave at least one blade without any notches. Place the second fan close to the mesh-covered floor at the far end of the wall in which the door is located and aim it slightly upward and at the center of the wall. Turn this fan on high and leave it on during the entire time you are inside the Faraday Cage, whether you are inside the inner chamber or the door to it is open or closed.

Repeat the notching process with the third fan. Place it at the corner of the soundproof chamber diagonally across from the door. Aim the fan so that most of the air is directed toward the wall opposite the door. Some of the air should catch the end wall of the inner chamber. Turn this fan on high and leave it on during the entire time you are inside the Faraday Cage room, whether or not you are inside the inner chamber or the door to it is closed or open.

Because these fans have a different number of blades, operate at different speeds, and have notched blades, they make a lot of noise. In addition, the air they push against the outside walls of the soundproof room will strike the walls in constantly changing, random nonpatterns.

Even though you have made it virtually impossible to hear conversation through the vacuum of the wall panels, the constantly changing wind from the fans will shake the outer walls and greatly overpower any fluctuation that might escape because of a faulty vacuum. The random noise from the fans prevents even the most sophisticated computer from unscrambling any voice-generated sound from inside the chamber. They also serve to constantly test the soundproof status of the inner chamber when the door is closed.

Caution: If you can hear the fans from inside the soundproof chamber with the door shut, the vacuum in one or more panels or the joints between them has failed.

To fix a sound leak, determine where the sound you hear is loudest and check seals. Sound leaks can usually be resolved by bonding a 1/16-inch skin overlay to the offending area and vacuuming it again.

Similarly, you can test for electronic integrity with any sensitive AM/FM radio. If you can hear a radio station, the Faraday Cage isn't working. If you don't have a directional antenna to locate the failed area, place a 2 + watt walkie-talkie inside the Faraday Cage and try to pick up its signal outside the cage. You will hear the walkie-talkie more clearly in one or more areas outside the cage. Patching the wire screen or improving the grounding (earthing) system will usually fix any electronic leaks. It is also possible to accidentally create a zone of vulnerability if the screening material is not identical throughout the cage. If this happens, replace the "odd" screens and reconnect the ground between the new and old Faraday screens.

Lights and Other Gadgets

There must be no electric device inside the soundproof acrylic chamber. That means no lights and no electric outlets. If your meeting involves bookkeeping, *you provide* a battery or mechanically operated adding machine. *Never* let a guest bring his own pocket calculator inside the room.

Since the inner chamber is constructed entirely from transparent acrylic material, lights inside the Faraday Cage room but outside the acrylic chamber will adequately illuminate the inner meeting room. It is best to hang 150-watt soft white electric lights near the ceiling and the four corners of the room. Illumination from above is more nearly normal, and placing a light at each corner of the room will remove harsh and unflattering shadows. If the illumination is too bright, use 60- or 100-watt bulbs. If it is too dim, use more lights. Do not use lights brighter than 200 watts. Be sure all lights are far enough (usually eighteen inches or more) from any acrylic surface so the heat does not affect acrylic seams or soften or distort the acrylic, glue, or silicone gel.

SAFETY

Don't kill yourself over a conversation. Other than the canary, the only absolutely required gadget for your bugproof room is a timer, similar to the type used to make enlargements in a photographic darkroom.

Nearly all of these timers have built-in electrical outlets, which the timer turns on or off. Most good timers cost between $20 and $75, and some of them have normally open circuits. If you can't find one with such an outlet, modify the one you use so that it operates in a normally open condition. That is, instead of keeping a light on during the timed period, you want the timer to keep a light off when it is timing and turn a light on when the time is up. (Be sure the timer can be set for five to ten minutes.)

You can modify a normally closed darkroom timer to operate normally open by adding a solenoid switch. This will let you plug the light into the solenoid switch instead of the timer itself. Then, when you set the timer for five to ten minutes and turn it on, the current from the timer will keep the solenoid open (and the light off) until the time is up. When the timer shuts off, power from the timer to the solenoid will stop, and the light will go on.

Warning: The purpose of the external timer is to warn you that the air in the chamber is no longer safe to breathe, hopefully long before your canary feels the effects.

First, you must be sure the light bulb works each time you set the timer. Second, having two operating bulbs is a good idea. Third, even though you buy the world's best timer, it is outside the sealed room and can't warn you about contaminated inside air. Fourth, do not take a professional air sampling "sniffing device" inside the room with you. They can be tampered with, they may fail, and they are a great place to hide a bug because they are not transparent and you can't take them apart for inspections.

To be sure you notice the warning lights, you should modify the light sockets to make the lights flash. Most hardware stores that sell lighting supplies also sell flasher units for regular 110-volt light bulbs. These look like coin slugs or fuse-box slugs and can be placed inside the light socket between the screw-base of the bulb and the electrical contacts. They function to interrupt the current that passes between the socket and the bulb when the power is on and cause an ordinary 110-volt light bulb to flash on and off to capture your attention. I like to use two 100-watt light bulbs, in side-by-side reflectors, aimed eye-level at the inner chamber. One 100-watt bulb is red, and the other is blue. When the timer stops and the two warning lights start to flash, they seldom flash simultaneously. This "police car" flashing effect *will* get your attention.

Don't do what one fellow suggested: use a loud police siren instead of the flashing red and blue lights. If you've done a good soundproofing job, you'll never hear the siren. Everybody I know pays attention to flashing red and blue lights—even those who ignore sirens.

Finally, one more time: *don't forget the canary!* Once you're inside the soundproof chamber, nobody can open the door from the outside. The door opens outward, and there is no outside handle to pull on. The inwardly angled nesting of the closed door prevents it from being crashed in.

No one will be able to break down the door in time to save you should you pass out! No matter how hard they try.

FAIL-SAFE BACKUP

If that bothers you, build a small, secret, knock-out window into one of the panels. Place it in an obscure place, preferably on a back wall, close to the floor where you can kick it out. Don't tell *anybody* about it.

At least then, if a "trusted" associate decides to block the door and watch through the transparent wall as you slowly suffocate while red and blue lights flash in your face, you can kick the secret window out and breathe.

If you're afraid somebody will shoot you while you're inside the room, build the inside skins of bulletproof acrylic. It's transparent and the best possible material for your walls, ceiling, floor, and door, but it's really expensive. There are some folks who need bulletproof/bugproof rooms—and *can* afford them!

To be of any value, a "kick-out" window must be secret. Read this page, carefully cut it out, and destroy it! If you don't, others may search for the window. If they do, a window will be useless to you should you need to use it! There is no other reference to a "kick-out" window. If you plan to build a "knock-out" window, destroy this page.

CHAPTER SIX

MOBILIZE YOUR BUGPROOF ROOM

FINDING A MOBILE HOME FOR YOUR BUGPROOF ROOM

If you think about it, there is little about a bugproof room (at least a good bug-resistant room) that can't be built into a self-contained motor home or large customized van.

In many ways, remodeling a motor home is easier. It certainly solves a lot of problems regarding where to put it, how to guard it, and how to maintain a nearly invisible identity profile for all who enter and leave it.

Sometimes, of course, you *must* meet clients or associates in a conference room environment. For most purposes, a fixed location is the only one that makes sense. In addition, motor homes have an image problem.

Many customized motor homes and vans are every bit as impressive and classic as a posh office. And they can be even more expensive than they are impressive. In the final analysis, whether or not an antisurveillance vehicle will work for you is a function of who you are and/or the image you hope to project.

Even if you've got a $70,000 supercustomized, self-contained vehicle with posh appointments, a mobile until won't be as professional in image as an office in a high-visibility building with a prestigious address.

A mobile security room also may have implications you don't want or can't afford. It may imply that you frequently deal with unsavory folks who don't dare show their faces in public, because they are wanted by the FBI or otherwise have a rank aroma about them. If so, you *will* take on the aroma of guilt, by that implied association. Be warned, if the people from whom you want to keep your secrets find out about your mobile security vehicle, you may draw a lot of intensive and immediate special attention.

No Problem for Most Plain Folks

On the other hand, a customized antisurveillance van or motor home can be pleasant, comfortable, convenient, and secure. If meeting in a nice-looking, comfortable motor home with out-of-sight social amenities isn't a problem, modifying one to be bug-*resistant* can be quick and easy. Not cheap—just easy.

Tax deduction? If you have or want a posh motor home or customized van, you may be able to deduct it as a business expense, because it is a necessary mobile security room. If you claim it, do so only if you can afford to have the government know that you are in a business that must keep secrets.

Furthermore, if you are careful with your modifications, nobody outside the vehicle should know that it is special and neither should your visitors—unless *you* want them to know.

Whether or not you tell your clients or associates about the antisurveillance features of your vehicle is a business and security decision that you must make logically. Never boast about it—or any other safety or security system, for that matter. Bragging and other forms of exhibition compromise any system and make you look careless and unprofessional.

"Don't Bug Me," Said the Van

Since protecting the vehicle from electronic bugging is the most difficult problem to solve, you might want to consider not protecting the vehicle itself from electronic snoops—but parking it in a Faraday garage. Or, you might want to do both. For example, carry on your secret transactions in the Faraday vehicle anywhere; your top secret transactions inside the vehicle, only when the vehicle is inside a Faraday garage.

Otherwise, you can adequately bug-resist a vehicle if you isolate the conference area from the driving compartment, contain the conference area in a Faraday environment, ground it when you are moving with the kind of antispark "grounding drags" sometimes used by gasoline tankers, and with one or more static grounding devices when you are parked. (See Fig. 8.)

You already know everything you need to know about vacuum panels and Faraday Cages. Except perhaps if you want to use an 18-wheeler. I personally don't believe a mobile unit can be made truly bugproof, but some others do, and they may be right. Nearly every antisurveillance expert will agree that a bug-resistant mobile unit is at least as good technically as a fixed-location bug-resistant room. To repeat: if a bug-resistant mobile unit is parked inside a Faraday garage when you hold meetings, the combination can be bugproof.

No, not an Acrylic Van

The primary reason for building the inner chamber of a surveillance-free room of acrylic is to make it transparent. You can sweep a room today, but how can you be sure some night visitor didn't hide a bug if you can't make a visual inspection?

That's the big problem with any fixed location. Obviously, you can't take a fixed-location, bugproof room home with you. Not so with a vehicle, whether it's a large customized van or a full-size luxury motor home. If you can take it home, you can take it anywhere. And anywhere can be a secure place—with plenty of isolation, locks, dogs, and surveillance cameras.

It may help to think of your bug-resistant vehicle as "pure" right after you finish the modifications. You know it remains pure only until you leave it alone with somebody else. ("Trusted" associates are the most dangerous because some degree of resentment lurks in the hearts of most people.) From the day your clean van is finished—and the first minute you leave it—you may not be able to tell if it has been "admired" from a distance, but there are a few traps you can set that will let you know if it's been violated. If somebody *has* got next to it you need to *know it*.

Backup the Backup

You need at least two motion sensors, which don't cost much. Place the primary sensor in a logical place and connect it to whatever you want—a telephone dialer, alarm bell, or lights. Don't connect it to a transmitter unless you use a receiver to activate something obvious: a remotely controlled floodlight, bell, or siren.

Think cause and effect. If a light goes on, there must be a sensing device. Expect the first sensor to be found and neutralized. Typically, an intruder will trip your alarm and flee. He'll watch for a response. When none comes, he'll return to finish the job. You want him to find the first sensor, so he won't look for your backup systems. If he flees without damaging your vehicle and doesn't return, fine. If he does return, you want him to quit looking after he finds the throwaway sensor. Never connect any backup sensor to an obvious device (light, bell, or siren) that is triggered by your throwaway sensor.

Make your first sensor part of a working system and be sure the professional appearance and quality of that sensor is consistent with the professional quality of the property it protects. Nobody out to plant a bug in your vehicle will believe you haven't protected it in some way.

Now put the additional sensors in less logical places. Let them do only one task—transmit to one or more well hidden remote cameras located where they will cover the entire area. Use equipment that will record clear pictures in whatever ambient light will be available should somebody invade the space near your vehicle. This may require twenty-four-hour tamperproof lights, infrared lights, or very low light (VLL) or "Starlight"-capable camera lenses.

Put at least one VCR camera or motion picture camera in a Faraday Cage. A real professional out to bug your bugproof room—fixed or mobile—will degauss the area before he leaves and that will erase all magnetic media (including your VCR tapes) in the area.

I prefer low-light video cameras for instant tape replay because film has to be developed. The camera should have battery back-up and an FM on switch that has a thirty- to sixty-second timed off switch. In this situation, when the motion sensor transmits its signal, the camera is turned on and operates silently for a minute or less until the timer turns it off. If the motion continues, the sensor turns the camera on again. A standard VCR cassette has 360 minutes' worth of protection and, operated in thirty- to sixty-second bursts, should last for at least a month. A Super-8 motion picture camera has the same coverage on film at one frame per second (time-lapse) speed.

The theory, of course, is that the intruder will look for and find the first sensor and disarm it (or flee), while the additional sensors continue to function. Meanwhile the sensors have turned on the camera(s) and you will know who cared enough to visit your vehicle *and what they did.*

If you know you've been bugged, you have lots of useful information. First, you can expect future conversations to be overheard. Second, you can infer that prior conversations have not been bugged—unless your visitor only changed the batteries in an extant bug. Third, you know there is a bug, so you can remove it. Fourth, you know there is a bug, so you can leave it in place and exploit it for self-serving disinformation purposes, as my friend did with his reverse-sting operation. Most importantly, if you've been bugged, you know somebody out there cares enough to put you under surveillance—and that means your "fears" of being watched are real and not a paranoid reaction.

Never hard-wire a sensor to a camera. If an intruder finds the sensor, he will look for and find the camera.

A WARNING ABOUT GUARDS

Never trust a guard to protect or be anywhere near your antisurveillance vehicle or inside a fixed-location bugproof room.

Generally speaking, a guard is bored, underpaid, and too often thinks of himself as some kind of undiscovered private television cop who not only will snoop out of curiosity, but will want to improve his personal image and "professional status" with his buddies by bragging.

I believe most guards are honest and conscientious. That is especially true of men who supplement their military retirement with part-time work. Unfortunately, that's not true of all guards. A few are drunks, some are incompetent, and occasionally one is just plain dishonest—a private cop who looks for targets of opportunity amongst the property he guards. Your property is, after all, valuable enough to need guarding. Don't forget that many guards are informants and not always police informants. All human guards can be bribed, threatened, or intimidated.

When a guard supervisor tells his men to report anything unusual, it too often really means "tell me something I can sell or trade." The supervisor may or may not use the information to his personal advantage. If he does, it is always at your expense. Your antisurveillance vehicle is unusual. Its existence is valuable knowledge that is worth selling or trading. It is clearly an unusual target of opportunity.

Finally, the most a guard can do for you is apprehend somebody or call the cops. In either case, police will be involved.

Do you really want to have police involved? Do you want to get a call from them? Or have them inspect your vehicle? Or have your vehicle become part of official police records? All countersurveillance information is too juicy to ignore. How juicy? Let a cop inspect your vehicle, and the chief will know tomorrow and the mayor the day after—providing they speak to each other.

All law enforcement administrators are bureaucrats, and no bureaucrat will put your best interests ahead of his own!

CHAPTER SEVEN

NOTES, REMINDERS, AND OTHER TIPS

FIRST, TWO LEXICOGRAPHY NOTES

Michael Faraday is the scientist who discovered the "field-free" room concept in the 1800s. Thus we can say that an area inside a Faraday Cage has been "Faradized" (verb); or if we're going to make it safe we are going to "Faraday" it (infinitive form of verb); or if the job is well done one might say, "I like your Faraday" (noun). This room has been Faradayed (verb). Take me to the Faraday room (adjective).

As an author, my ego demands that I name a bugproof room that has been made soundproof (via vacuum acrylic walls, door, ceiling, and floor) and is nested inside a Faraday Cage after me. I'll call it a Glas room (adjective). (Glas with one "s" please.) That is, the room has been Glased (verb); the Glas looks nice (noun).

HOW MUCH IS THIS GOING TO COST?

Experience teaches that the two most difficult problems in actually building a bugproof room involve the acrylic and the vacuum pump.

To check on 1990s prices, I visited a professional glass door and window retailer. This was a large, well-stocked supplier to remodelers and do-it-yourself folks. They maintained an inventory of clear acrylic (optical quality) in 1/16" and 1/8" thickness only. Their sheets measured 4' x 7'. They did offer to custom-cut the acrylic at no additional charge, but their per sheet price was ridiculous. This glass specialty outlet wanted $144 plus tax for each 4' x 7' sheet of optical quality clear 1/8" acrylic. They said they could special order 1/4" sheets of 4' x 7' acrylic but warned me that it would be too expensive.

When I complained about their prices, they tried to sell me insulated glass panels and sound-reflecting and sound-dampening windshield-type glass. The truth is that insulated windows or glass similar in composition to automobile windows do reflect and absorb sound. That is helpful, but it just isn't good enough.

While the friendly sound engineer in a recording studio can use his professional equipment to filter out unwanted noise and conversation, the unfriendly surveillance professional will use similar equipment to isolate and amplify the same conversation. The message here is that almost good enough and sound suppression just aren't worth a thing.

The acrylic you need is the most expensive part of building a bugproof room. Never buy from specialty outlets like the glass window and door shop I just described. They not only charge too much, they will try to sell you what they have available, and it just won't do the job you need.

I checked the yellow pages and discovered a nearby building supply outlet. They sold acrylic panels and maintained a large off-the-shelf inventory at the following single-sheet retail prices:

- $20.98 per sheet for 3' x 6'⅛" optically clear acrylic.
- $9.89 per sheet for 2' x 4'⅛" optically clear acrylic.
- $2.38 per sheet for 2' x 4'⅛" clear (not optically perfect) panels, normally used by builders for transparent ceiling light panels.

You should have no trouble finding similar prices and off-the-shelf inventory at a building supply center near you.

It doesn't take much imagination to see that you can bond together inexpensive sheets of ⅛" panels to make everything you need, including the floor and door of a bug-proof room. Even so, you may wish to spend the extra money to special order ¼" sheets (or even ½") material. If so, find a source that will sell you ¼" sheets (4' x 7' or 4' x 8' clear acrylic) for $100 or less.

If you have trouble finding a source for extra thick transparent acrylic, visit any liquor store or check-cashing agency in a high-crime area. Just ask the manager where he buys his bulletproof glass.

In practice, the smaller size (much cheaper) sheets are nearly as easy to use as the 4' x 7' panels because you are going to honeycomb them into acrylic triangles and panels and bond them together anyway.

CONSTRUCTION TIPS

Cutting the acrylic seems to be a big problem for some people. Remember that the smaller the teeth in a saw blade, the finer the cut. Some optically clear acrylic is brittle. Buy a single piece and experiment with it before you invest a lot of money. If you aren't successful with the test panel and can't find (or trust) someone else to cut it for you, use the thinner and/or more flexible sheets. They won't be quite as clear optically, but they will be transparent and you will be able to inspect for hidden bugs and other devices once the panel (or triangle) is in place.

The same is true for drilling the acrylic. If you have trouble, take your sample to a building supply outlet and explain the problem. They will be able to help. (If someone wants to know what I'm making, I usually say I'm building or remodeling a soundproof recording studio.) If you continue to have trouble when you drill holes, downgrade from the brittle, optically clear acrylic to the thinner and more flexible material.

Mounting vacuum valves seems more complicated than it really is. First, find the valve you intend to use. The valve size will determine the size hole you need to drill. Plan to mount the valve on the outside of the hole because the vacuum will be inside and will try to suck the valve into the hole. Lots of glue and silicone gel work wonders. Try to avoid unnecessary lengths of vacuum hose. Most hose is built to withstand internal pressure (inflating forces). Some hoses tend to collapse when the vacuum (very low inside pounds per square inch) is high. The shorter the hose, the better. Likewise, small-diameter, thick-walled, heavy-duty hose works best. I like to use short lengths of propane gas hose and valves. Screw-to-close valves, like those on propane tanks and hoses, work best. Be sure to cap the valve after the vacuum pump is disconnected.

Some persons have trouble sealing panels that abut. Again, generous applications of glue—I like hot transparent glue from an inexpensive glue gun—and generous portions of silicone gel do an excellent job. With few exceptions, the things you glue together will not bear weight or other stress. The glue and silicone gel mostly serve to hold them in place and make them airtight. There are exceptions, such as attaching the handle on which you pull to close the inner chamber door. One of the many super-adhesive glues should be more than strong enough to bond handles to doors.

WHERE TO BUILD THE BUGPROOF (GLAS) ROOM

The location of your bugproof or bug-resistant room depends on you and your professional needs. That is true whether you are a lawyer, a contract killer, a drug dealer, or the operations officer of a secret strike force.

The need for professional-quality safe rooms for conferences is more common than most people recognize. I know of one major hotel that rents its bugproof conference room for $250 an hour. (I've seen it, and it's not even bug-resistant, just impressively swept by a hotel employee in a uniform with a black box who then stands guard outside the door during the meeting.)

Whatever your motive—security, self-promotion, or capitalist greed—you must first estimate how important maintaining a low profile is for you personally and for your clients. For example, if you are a lawyer who specializes in acquisitions and mergers, your clients may not want to be seen together. If that is the case, be sure there is a logical reason for you and your clients to be seen in the vicinity of the bugproof room.

It is sometimes appropriate to locate your bug-resistant conference room away from your office and to fly a false flag over the entrance. For example, the raised letters on a brass plate on the solid outside door might read: "Zurich Custom Jewelry Importers—By Appointment Only." Nobody would think twice about special security locks and procedures at a place like that if they chanced to see you or a client enter or leave. A quick illustration from the world of espionage may be helpful.

Agents are almost always nationals of the country being spied on. Foreign case officers run the agents. Meetings between agents and case officers are touchy, especially since agents tend not to be experienced professionals and often are visibly nervous. For centuries, case officers have routinely met the agents they handled in whorehouses. Why? Because married men are nervous about their wives, bosses, security officers, or others finding out they use prostitutes. And men and women from all levels of business and society use safe-sex prostitutes.

You probably won't want to install a bugproof room in

Sally's Pleasure Palace, but a neutral location midway up a tall office building where your client might logically visit his bank, his accountant, his attorney, his barber, his broker, or his custom import jeweler will do nearly as well.

Real world bug-resistant and bugproof installations are not very exotic. In about 90 percent of the fixed locations with which I'm familiar, the bug-resistant conference room was an openly acknowledged and logical modification to an existing meeting room. If you upgrade a working conference room, you may have to break some hidden-agenda use patterns with a formal announcement: "For security reasons we have made a significant financial investment to make our conference room free from possible surveillance. As a result the conference room will no longer be available for casual use, lunch, or coffee breaks."

Controlling access to the room is essential. As you consider where to locate your room, how to limit and control access, and whether it really needs to be bug*proof*, you may want to review earlier chapters in this book. Whom you allow into the room and whom you tell about the room become almost as important as the room itself.

Most persons don't recognize they have a secret until it's been compromised in some way. If you've got a true secret—one that you alone know—you must clearly define *whom* you need to tell, *why* you will tell them, *when* you will tell them, *where* you will tell them, *what* (how much) you will tell them, and *how* you will tell them. The only true secret is one that you don't share with anyone and about which you *never make a written record*.

A final parting shot. Don't let anybody tell you their secret. If they don't tell you—and their secret is leaked—they will know you didn't tell. And vice-versa!

THE TROUBLE WITH TIME

It is always appropriate to plan security countermeasures in terms of the future. Today's associates and trusted friends may be tomorrow's competition or enemy. Lots of otherwise secure folks have gone to jail because a "friend" gave them up years later to save his (or her) own skin. Every living person is subject to bribery, to threats, and to many other forms of extortion. Over time, every situation will change, and every person in every situation will change.

Try, if you will, to imagine a current relationship that is so committed, so secure, and so filled with faith that it can't be tempted by some tomorrow's chance encounter, time's constantly changing spheres of influence and social contact, or the evolving physical, political, and financial circumstances in which we each must live.

"Ill luck, you know, seldom comes alone."

—Miguel De Cervantes, *Don Quixote,* (1605),
Part I, Book III, Chapter 6, page 135.

DON'T BUG ME

THE LATEST HIGH-TECH SPY METHODS

M. L. Shannon

DON'T BUG ME

I thank the many people who have provided me with information and suggestions that made this book possible. Most of them have asked that their names not be published. They have not. Others declined to identify themselves so I do not even know who they are.

DON'T BUG ME

THE LATEST HIGH-TECH SPY METHODS

M.L. Shannon

PALADIN PRESS
BOULDER, COLORADO

Also by M.L. Shannon:

The Bug Book: Everything You Ever Wanted to Know about Electronic Eavesdropping . . . But Were Afraid to Ask

Digital Privacy: A Guide to Computer Security

The Phone Book: The Latest High Tech Techniques and Equipment for Preventing Electronic Eavesdropping, Recording Phone Calls, Ending Harassing Calls, and Stopping Toll Fraud

Don't Bug Me:
The Latest High-Tech Spy Methods
by M.L. Shannon

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"Sed quis custodiet ipsos Custodes?" ("But who is to guard the guards themselves?")

Juvenal (ca. 50 — 130 A.D.)
Satires

WARNING

This book contains a considerable amount of information about surveillance methods and equipment, some of which has never been published.

It is intended as a manual for self-defense against eavesdroppers. I do not encourage anyone to use it to invade the privacy of any other person. Bugging people is against several laws. It could get you arrested and put in a place you wouldn't like very much.

The author and the publisher are not responsible for the use or misuse of any information contained in this book.

INTRODUCTION

I believe that everyone in America should be allowed to enjoy the right guaranteed by the Fourth Amendment: the right to be left alone by government and others who would invade their privacy. I believe this, but not everyone else does.

There are many people in this country—and not just federal agents—who can listen to everything you and your family are saying in your home, on your telephones, or in your office or car. They can and sometimes do. I think that everyone has the right to know about this.

Information about the methods, types of equipment, easy availability, effectiveness, and means to find and defeat them should be available to everyone who wants it.

People are entitled to get what they bargained for when they place their security, peace of mind, and their cash (usually a lot of the last) in the hands of someone who claims he can make their homes and offices secure from spies and wiretappers.

SURVEILLANCE AND ETHICS

Bugging people may be unlawful, but it is not always morally wrong, e.g., when a person is being victimized by another and law-enforcement agencies are unable or unwilling to help. Bugging should be used only in self-defense. There are no "Equalizers" and "A-Teams" in real life.

The guy was a real lowlife, very big and very mean, and he had a lot of friends. Everyone who frequented the bar was afraid of him, especially the bartender, who was his ex-wife. He would come into the bar drunk and force her to go with him on his motorcycle. Sometimes he would beat her, and when she came back to work, everyone saw her bruised, puffy face.

She called his military commanding officer, but he told her that without evidence or witnesses, there was nothing he could do.

She called the police, who said they would "drive by" and look for him, but they could never catch him at the tavern.

One of the bar regulars was an electronics technician, who, after seeing her abused once too often, told her he might be able to help. He built a bug, showed her how to turn it on, and suggested some hiding places for it. The next time her ex-husband forced her to go with him, she hid the bug in his bedroom.

For ten nights the technician parked his old Dodge van near the guy's apartment and listened until he got something he could use: the sounds of him verbally abusing and then beating another woman he had taken home.

The next day, he made copies of the tape and sent one to the guy, along with a note, and another to his CO. The ex never came back to the bar again. This is a true story.

I understand the helplessness law-enforcement officials must feel when arrested drug dealers and other criminals are back on the street within hours; I sympathize with them if they bend the rules to try to keep known criminals off the street. I don't like crime either.

What I do not sympathize with is the government's abuse of the power it has to spy on people who are not criminals and are not even suspected of a crime, such as political activists and protestors who disagree with the way the administration is running the country. This I am against.

When Richard Nixon had Assistant U.S. Attorney General Morton Halperin's phones tapped, was there a clear and present danger to national security to justify this action? Nixon remarked of this: "When a president does it, it is not illegal."

During the Nixon administration, federal agents tapped the phones of those they believed to be political dissidents, and U.S. Attorney General John Mitchell tried to justify this by claiming that "national security may involve threats from domestic groups."

The U.S. Supreme Court disagreed with Mitchell, and ruled that the government could not indiscriminately tap the phones of suspected dissidents.

The Federal Bureau of Investigation (FBI) has, for years, tried to get public libraries to provide the names of patrons who check out certain books that it considers seditious, and agents have admitted that they go to libraries to look for people who read publications such as Aviation Week, Defense Electronics, and other technical magazines. Is reading a magazine that anyone can subscribe to a threat to national security?

A few years ago, the FBI conducted a large-scale surveillance operation against members of a group of people who were protesting the United States' involvement in El Salvador, and the agency got caught doing this. The punishment for the agents involved in violating surveillance laws was not a long prison term, as the laws specify, but rather a short suspension without pay.

There are people who spy on others for selfish, malicious reasons or, sometimes, for apparent reasons other than the fact that they have the opportunity. The following is one such example.

Sylvia was a popular girl; she was pretty, sweet, innocent, friendly, and trusting. She was twenty-two, had a job she liked, and enjoyed her bit parts in the musicals at a local open-air theater. She had a lot going for her, but apparently someone didn't like her.

Strange things kept happening to her. She called a friend and arranged to meet her at a shopping center. When she got back to her car, she found that someone had let the air out of the tires. Another time she made a date to go to a movie, but the guy called to tell her that someone had broken his windshield, and he was unable to take her because he was too upset. On another occasion, she called a taxi, but after waiting for a long time and then calling to check on it, she was told that someone had cancelled it. Too many strange things were happening, and it distressed her.

One day a friend whom Sylvia confided in suggested that maybe someone was listening in on her telephone. This was even more distressing—she was so naive that she couldn't believe anyone would do that. This friend knew a guy from high school who was in the school radio club and known as an electronics kook. She called him and asked if he knew how someone could listen in on someone's telephone.

He knew a little bit about phone tapping, and he agreed to look at Sylvia's phone line. In just a few minutes, he found a wire connected to her line in the basement. He traced it to a line going to another apartment, and they called the police and the phone company. The police arrested the man who lived in that apartment. Sylvia was there when the police took the man away; she didn't even know him.

• • •

I am against using surveillance for selfish or malicious purposes. I know what it is like to be bugged.

A SPECULATIVE HISTORY OF SPYING

Sir William Blackstone defined eavesdroppers as, "Such as listen under walls or windows, or the eaves of a house, to harken after discourse, and thereupon to frame slanderous and mischievous tales."

Surveillance is as old as man. Supreme Court Justice Hugo L. Black observed of it that "the practice has undoubtedly gone on since the beginning of human society."

Even when our distant ancestors were living in caves, there were probably those who liked to spy on others—to see where they hid their food, to watch caveman with cavewoman, or just because they were nosey.

As the spoken language developed, some person probably discovered, man being a curious and inventive creature, that he could hear better by listening through a hollow reed or other such organic listening device; maybe a coconut shell was the original "contact microphone."

Speaking led to a way of recording what people had to say, the written language. At first, it was the exclusive property of kings and courts, the rich and powerful. Common people were forbidden from having books or knowing how to read them, sometimes under penalty of death by torture.

Hundreds of years passed before the peasants were allowed this knowledge, but the heads of state still didn't like the idea.

They had secrets they didn't want the people to read, but there were plenty of people who were determined to read. Government officials started to worry, and they developed codes to hide information from citizens who could now read.

One of the earliest of these was the "Caesar Cipher," which was a simple letter substitution like the cryptograms in newspapers. The Spartan code involved writing the message on a strip of cloth wound around a specific-size spear, then removing it. Only by rewrapping it on something the same size as the spear could it be read. Other codes had interesting names such as the Russian "Nihilist" and "Prisoner" codes, the "Corkscrew," "Rail Fence," "Spaghetti," and "Swinging Squares."

Codes were broken; new ones were devised and subsequently broken; locks were invented, followed closely by picks; and spying continued.

The earliest likely example of electronic spying was in the Old West, where outlaw gangs used stolen telegraphs and tapped the lines to find out what the sheriff was up to or the date of the next gold shipment. While no one knows for sure who the first telephone tapper was, it could have been Watson.

Soon the American Telephone and Telegraph Company was born, with its operator-assisted calls. But it was too easy for the operators to listen in, believed an undertaker named Strowger, so in 1889 he invented the mechanical "stepping switch" that automatically connected the lines, and the manual switchboards were replaced. This kept the operators from listening, but it was still easy for anyone else to tap a phone line.

In December 1947 Drs. Bardeen, Shockley, and Brattain, working at Bell Laboratories, invented the transistor, and the age of modern surveillance was born.

Today there are many high-tech methods of spying on others, and it has become big business—governments spend billions of dollars for satellites and supercomputers, microwave equipment, sophisticated bugs, lasers, and all types of other devices to spy on other governments and the American people. Industrial espionage has become a big business in itself, and easily available, low-cost surveillance devices have made it more common for people to spy on other people.

Knowledge has not kept up with the technology, at least not in terms of the general public's knowing how to counter electronic invasion by others. Anyone can buy a wireless microphone and use it to spy on someone else, but it's not easy to find a book that tells how to stop bugging or how to find a hidden listening device.

You won't find these books at Waldenbooks or B. Dalton, and they are not book-of-the month selections. The few listed in libraries' card catalogues are usually "missing" (checked out and not returned). This partly explains why people know so little about spying and countermeasures.

YOUR RIGHT TO KNOW

While researching this book, I went to several shopping malls with a tape recorder and notebook and asked people if they knew anything about spying, surveillance, and wiretapping. I got a lot of strange looks from people who hurried away as if I were maybe a spy or something. (Of course, maybe the black fedora, trench coat, and sunglasses had something to do with this.) I saw obvious anger in some faces, and one man replied, "Yeah, the government spies on all of us." But by far the most common reaction was a blank stare and a comment like, "Oh, well, not much. I never really thought about it."

People are still unsuspecting in an age where surveillance is so easy. Perhaps if they knew how easy it is to spy on others they would care, and if they knew that they can do a great deal to prevent being spied upon, they would want to know how.

This book is for everyone. It assumes that the reader knows very little about surveillance and presents information about different methods of eavesdropping, types of spying equipment available and how they are used and countered, and, finally, how to buy, build, and use some of these devices.

I like to think I have included at least a little information on every method of surveillance that exists, but there may well be equipment or methods I know nothing about. I would like to hear from anyone who does. Anonymous letters in care of the publisher (Paladin Press, P.O. Box 1307, Boulder, CO 80306) are welcome.

Finally, although this book is intended for everyone, each person's situation is unique. Some people are more likely to be bugged than others. Different people react to spying in different ways, and people have to decide for themselves how far they are willing to go to prevent their being bugged.

This book doesn't have all of the answers for every situation, but it has enough basic information to enable readers to know how to deal with the possibility of being bugged, protect themselves against it, and relate to professional debuggers on their own terms.

THE TRUTH ABOUT COUNTERSURVEILLANCE

There are people who claim to be countersurveillance experts and who are happy to take your money in exchange for sweeping your home or office for bugs. Most really are experts, but a few are not. Most are well-equipped; a few aren't. This book will help you tell one from the other.

You can start to separate the real pros from the wannabes by asking a few questions. Ask if they have a bug detector that will cover the low- and medium-frequency bands, or if they use a spectrum analyzer. Ask them about down-line phone taps and how they would look for them. Anyone who knows his business will not be offended by such questions. Remarked one private investigator who resented my comments after he said he could find any kind of surveillance, including an inductive down-line wiretap, "Who are you to question me, anyway? I have been in this business for twenty years, and I . . ." Another person who told me he did countersurveillance work didn't know what a nonlinear junction detector was.

There are established companies with experienced experts in the field listed in the yellow pages under "security consultants." I would start with them rather than someone who does debugging as a sideline.

Some methods of spying on people cannot be detected by any electronic countersurveillance equipment; others are difficult to find. Most, however, are simple to find. The real experts will tell you this. There are no methods of electronic surveillance that I know of against which you are totally helpless. Even if there is no way to detect some of them with electronic equipment, all can be dealt with and defeated. It may be inconvenient, and it may be expensive, but it can be done. You *can* protect yourself from electronic surveillance.

But remember, if you believe you are being bugged and decide to call in a team of countersurveillance experts, make the call from a pay phone. Don't let a spy know you suspect him.

WHY ME?

"Why would anyone want to bug me?" some of you are probably asking. Are you "important" enough to place under surveillance? What is important to some people isn't to others. You don't have to be rich or famous, a public figure, criminal, or political activist to be on someone's watch list—although it does help.

A small contractor preparing a bid on a small job can be a target. If a competing company knows what the competition is prepared to bid, it can bid lower. This is one way that small companies become large companies. A jealous spouse with twenty dollars can buy a wireless microphone and make you a target. One business partner thinks the other is cheating him, so he bugs him. Law firms bug opposition firms more often than people think because it never makes the newspapers. A neighbor bugs another neighbor because of some petty misunderstanding. Students bug teachers to get test information. Management bugs employees to find out what's going on or what they think. Strangers bug strangers just for the hell of it. The federal government has been known to bend the rules a little when they want to spy on someone. How many of these categories do you fall into?

In the several years I spent gathering information for this book, I interviewed dozens of people in dozens of cities. The interviewees included countersurveillance experts, debugging equipment manufacturers or vendors, law-enforcement personnel, former federal agents, lawyers, phone company employees, electronic technicians and engineers, victims of surveillance, and a few who had bugged others.

Big Business Is Biggest Offender

One conclusion their testimonies and other information I gathered make clear is that most illegal bugging is done by big businesses spying on each other or their employees.

Surveillance by the Federal Government

On the other hand, illegal surveillance by the feds appears to be less common than I (and most people) imagined. (But still not uncommon enough.) There are two apparent reasons for this. First, most surveillance is illegal, and if a federal agent gets caught conducting an illegal surveillance, he might lose his job (a job that could be very well-paying). Chances are, he would get off with a series of reprimands, but there are limits to what federal employees can get away with.

Second, surveillances are expensive. Who is going to pay for the equipment? While most federal agents have access to surveillance gear, they have to account for it, and once a bug is installed, it generally stays installed. You don't usually get it back, and quality bugs are not cheap.

Then, once installed, someone has to be in place to hear what the device is receiving. Unless it is a high-powered and expensive repeater system, that means setting up a listening post—usually in a van with agents to man it. To be effective, this has to be continuous. If an agent leaves for a short time, he may miss the information he is listening for. Stakeouts of this type can take a lot of time.

Finally, while the information received in this way may be extremely useful, it cannot be used as evidence in court.

Federal agents do conduct unlawful surveillance—they have been caught doing so—but it's not like they can bug anyone, anytime.

Of the People and by the People

Personal surveillance by ordinary people is more common than one might think. Bugs are easy to get and use, and the average person is totally defenseless against them.

Many buggers are close enough to the people they bug that they can access areas they want to bug without breaking in. These include friends, neighbors, and family members. With the same access, they can usually retrieve the bug when it has served its purpose, so it is never found and there is no record of it.

Even when a person or a business discovers that surveillance has been going on, the public rarely hears about it because he or it doesn't tell anyone. No one wants that kind of publicity.

Regardless of who is bugging whom, and how often, there are many who are concerned about it. At the end of this book is a list of companies that sell equipment used for surveillance or countersurveillance devices. There are more than forty businesses on it, and it is far from complete. For local vendors, look in the yellow pages under "security consultants." In a large city, there are a number of them listed, and these businesses are surviving, even thriving, even though the cost of sweeping an office for bugs is considerable, and the equipment is not cheap. People are paying this money for equipment or expertise because there is a need for it.

One of the professional debuggers we talked to made an interesting comment: "You look in the back of any of a number of magazines, electronics and like that, and you see ads for wireless microphones and phone bugs and that stuff. This has been going on for forty years, and if they weren't selling these things, they wouldn't keep running the ads." Someone is buying them.

THE LAWS THAT CONCERN SURVEILLANCE

This chapter is not intended as legal advice. It simply points out that there are laws against people bugging other people. The Omnibus Crime Control and Safe Streets Act of 1968, which breezed through Congress (368 to 17 in the House and 72 to 4 in the Senate), was intended as a tool to fight organized crime. For the first time, this bill made it legal for the government to "intercept wire and oral communications under specified conditions, with safeguards designed to protect the right of privacy," and it made it unlawful for people to do the same thing. "Specified conditions" were defined as a court order or a situation that was a matter of "national security."

The Omnibus Act reads in part:

"(1) *Except as otherwise specifically provided in this chapter any person who:*

(a) willfully intercepts, endeavors to intercept, or procures any other person to intercept or endeavor to intercept, any wire or oral communication;

(b) willfully uses, endeavors to use, or procures any other person to use or endeavor to use any electronic, mechanical, or other device to intercept any oral communication when

(i) such device is affixed to, or otherwise transmits a signal through, a wire, cable, or other like connection used in wire communication; or

(ii) such device transmits communications by radio, or interferes with the transmission of such communication; or

(iii) such person knows, or has reason to know, that such device or any component thereof has been sent through the mail or transported in interstate or foreign commerce; or

(iv) such use or endeavor to use

(A) takes place on the premises of any business or other commercial establishment the operations of which affect interstate or foreign commerce; or

(B) obtains or is for the purpose of obtaining information relating to the operations of any business or other commercial establishment the operations of which affect interstate or foreign commerce; or

(v) such person acts in the District of Columbia, the Commonwealth of Puerto Rico, or any territory or possession of the United States;

(c) willfully discloses, or endeavors to disclose, to any other person the contents of any wire or oral communication, knowing or having reason to know that the information was obtained through the interception of a wire or oral communication in violation of this subsection; or

(d) willfully uses, or endeavors to use, the contents of any wire or oral communication, knowing or having reason to know that the information was obtained through the interception of a wire or oral communication in violation of this subsection;

shall be fined not more than $10,000.00 or imprisoned not more than five years, or both."

The act goes on to say that agents, switchboard operators, and employees working in the normal course of their employment with a communication common carrier, the FCC, and telephone operators who are "making mechanical or service quality-control checks" are exempt from this law.

Also exempt is anyone acting for the president as a matter of national security. This law specifically states, "Nothing contained in the act or in section 605 of the Communications Act of 1934 shall limit the constitutional power of the President to take such measures as he deems necessary to protect the Nation against a clear and present danger to the structure or existence of the Government."

What this part of Omnibus seems to say is that:

- It is legal for the government agencies to bug people if they have a warrant or if the situation concerns national security—or if they don't get caught.
- It is against the law for people to bug people by using any kind of device that is attached to a wire or transmits a radio signal or has been transported through foreign or interstate commerce.

Since practically everything that could be used as a surveillance device is made—at least in part—in Japan, Taiwan, or Singapore, this would apparently include wireless microphones and other RF transmitters, shotgun microphones, lasers, and, in fact, virtually any method of eavesdropping except hiding "in the eaves of a house."

Section 2512 of this long, complicated law, states:

"Any person who willfully sends through the mail, or sends or carries any electronic, mechanical, or other device, knowing or having reason to know that the design of such device renders it primarily useful for the purpose of the surreptitious interception of wire or oral communications, or knows or has reason to know that such advertisement will be sent

through the mail or transferred interstate shall be fined no more than $10,000.00 or imprisoned not more than five years or both."

In general, this section seems to say that it is unlawful to make, sell, advertise, ship, or use surveillance devices that are "primarily useful" for spying on people. But where does it say anything about possessing such devices?

Wireless microphones are used more often than any other type of transmitter, and anyone can buy one. There are kits that when assembled are wireless microphones and telephone line transmitters, whose purchase or ownership is either legal (but whose sale is still illegal) or is not being enforced by the law.

Apparently, possession is not considered sufficient to constitute an "endeavor to unlawfully use"; if it were, then every person who owns a wireless microphone, baby monitor, or two-way radio would be violating the law.

The bottom line, as someone who claimed to be a former federal agent told us, is if federal officials wanted to, they could arrest anyone who owns anything that could be used for surveillance. Such is the power given to the government over the people by this act.

Although not everyone arrested and charged under this law would be convicted, most people would be bankrupted by the legal cost of a trial in U.S. District Court. But as there are so many places that sell phone tap kits and wireless microphones, it would also be prohibitively expensive to the government to locate, arrest, and try all of them.

To help control this problem, the Federal Communications Commission (FCC), or someone pretending to represent it, is getting into the act. All devices that transmit an RF signal have to be "type accepted" by the FCC, and this costs several thousand dollars for each model. The FCC has sent letters to companies that make these kits, according to an article in *Full Disclosure*.

Public Law 99-508 (the Electronic Communications Privacy Act of 1986, Title 18 USC, various sections) also concerns surveillance. It says (in part) that there are some kinds of radio telephone calls and radio transmissions that are legal to listen to and some that are illegal. This is discussed in more detail later.

In addition to federal laws, there are local laws against surveillance breaking and entering, unlawful entry, trespassing, and invasion of privacy.

Ultimately, however, the law is whatever the Supreme Court says it is.

SURVEILLANCE AND PRIVACY IN THE PRESENT

It seems that the federal government doesn't want people to be able to keep anything secret from it. One proposed bill—S266, the so-called "counterterrorism" bill introduced by Senators Joseph R. Biden, Jr., (Democarat-Del.) and Dennis DeConcini (Democrat-Ariz.)—would have forced manufacturers of hardware and software that can encrypt data to provide the government with a secret key to break the code. It did not become law . . . this time.

But people like Biden and DeConcini never give up. They'll be back.

RSA Data Security, Inc., has an encryption program that the computer industry wants to use as a standard, but the National Security Agency (NSA) is trying to prevent it because the program is too secure. Even the NSA cannot break it.

The founding fathers could not have conceived of computers in the eighteenth century. If they had, they probably would have mentioned them in the Fourth Amendment, along with personal effects.

It is well known that cellular phones ("the party line of the 1990s") can be easily monitored. There is an effective method of encrypting cellular phone traffic that has already been installed by GTE Mobilnet. This would provide the privacy that vendors promised when the cellular net was new. Apparently the government can use the new method, but as of this writing, it is not available to the general public. The key contained in a signal that goes out on the cellular data channels changes frequently and has already been given to the government, I've been told.

Motorola makes a land-line phone-scrambling system called SVX that is very secure, which the government uses. Try to buy one. Motorola also makes a chip called the Vulcan, built into some of its Saber brand two-way radios, that encrypts transmissions with the DES. The FBI and other federal agencies use these radios, but Motorola does not sell them to the public.

New laws regulate the use of scanners. Florida, Michigan, and New Jersey have outlawed the use of them in motor vehicles, and more states are likely to follow. Federal intelligence agencies, I have been told, collect names of the purchasers of scanners. Some local police also keep records of people who own them, and bills have been introduced in the U.S. House of Representatives that would require registration of scanners, two-way radios, and possibly even pagers.

Telephone companies keep a computer record of every call made on their systems—not just long distance, every call—which is available to law-enforcement personnel.

When a woman who lived in California's Silicon Valley area disappeared and wasn't heard from for several days, her family called the police. In the investigation, the police learned that the woman had called home and talked to one of her children just after she left. She said she was calling from a pay phone at a nearby convenience store.

The police were able to access the telco records and obtain the number from which the call had actually been placed. It seems that she had set up temporary housekeeping with a bus driver in a nearby city.

The van Eck method of computer snooping, described in Part V, is probably used by the government to eavesdrop on people's personal and business computers, as there is apparently no law against this.

Wang Laboratories was preparing a demonstration on TEMPEST, a method of protecting computers from van Eck, but, allegedly, the feds moved, classified the technology, and convinced Wang to cancel its seminar after threatening to make arrests.

Apparently the federal government doesn't want people to know how to protect *their* computer systems from surveillance, even though it can buy a TEMPEST secure system from Wang to protect its systems. National security?

The trend is clear. Sooner or later Omnibus will be amended, or new laws will be enacted, to further weaken the Fourth Amendment and broaden the power of the government to use surveillance against the people it is supposed to serve.

Why is this happening? One argument is that this oversight power is needed not because the feds are the bad guys, but because they are fighting a losing battle against crime, much of it drug-related. Maybe if we didn't have such a serious drug problem in America, we would all have greater freedom and personal privacy.

On the other hand, maybe the present administration wants a police state. Sometimes it seems that way. When you have a spy for president . . .

There is little we can do to change this, but for now, we can keep them out of our living rooms.

PART I

INSIDE DEVICES

MICROPHONES

The simplest type of bug (generic term used here for any kind of listening device) is an ordinary microphone. It can be hidden anywhere in the area under surveillance with a wire leading to the listening post, which might be an adjoining apartment, in the backyard behind the rhododendron bushes, across a fence, or just about anywhere.

The listener may have a tape recorder or just a small battery-powered amplifier and earphones. The inside wires can be hidden under the edge of carpeting or inside the cracks between a wall and door frame, and the microphone can be as small as a pencil eraser.

A microphone can be used from an apartment or office next to the target, with a small plastic tube inside a wall socket to feed the sound into it. The area inside the walls in which the wiring is installed is usually common to the rooms on both sides in apartment and office buildings. Darken the room, remove the plastic plate from a wall plug, and look in. You might see light coming through the small openings. If light can get out, sound can get out.

A carbon microphone can sometimes be hidden behind the plastic plate that phone wires come through and then be connected to the two unused (black and yellow) wires that are in the phone cable. The listener can be found by following the cable. Listeners can connect these wires to the two unused wires of their own phone cable at the telephone company "66" block at which all the lines enter the building, and they can listen in the comfort of their own apartment. This is called a "bridging tap."

Most, but not all, microphones can be located and made useless with ultrasonic sound (USS) generators.

There are various types of microphone elements. The condenser or "electret" can be very small: 3/8-inch diameter and 1/8-inch thick. The electret requires a small battery, but it can be at the other end of the wire. This is the type that is built into some tape recorders.

The carbon microphone is the type used in telephones. If you have a phone with screw-off caps, take off a cap and take a look. These microphones usually are much larger than the other types and harder to hide, but they can be as small as a quarter.

The carbon microphone requires a DC power source, which is why there is DC voltage on the phone line. Inside are a bunch of small carbon granules. A voice entering the lines changes the resistance of the granules, and these variations are received by another phone as sound. Since it is a DC device, it doesn't pick up humming and interference so it doesn't require expensive shielded cable.

Dynamic and magnetic microphones are the smallest, as tiny as 1/4-inch square and 1/8-inch thick, and do not require a power source. These and the Electret are AC devices and usually need shielded cable, an inside wire that has a grounded braided copper covering. Long unshielded wires attached to them act as antennas and pick up noise, usually the 60-cycle hum from power lines and appliances that interferes with the sound. Also, there is audio equipment to prevent this problem so these microphones will work on ordinary phone-line type (unshielded) wires.

Another problem with microphones is that the sound they receive can fade as the distance between them and the people being listened to increases. The sound can also become distorted in a room with poor acoustics. A microphone preamplifier will improve the quality of the sound, as will equalizers and certain types of filters. Viking International has some good audio gear that will correct this problem, including the model 12DB preamplifier.

Contact Microphones

A common microphone is the contact type, sometimes called an electronic stethoscope. This is the device that magazine ads claim can "hear through walls," and it can do just that with varying degrees of success, depending on the quality of the device, the thickness and composition of the walls, and the background noise.

Try placing the open end of an ordinary drinking glass against the wall of the room you are in, and press your ear tightly against the bottom to see what you can hear in the next room. A contact microphone will hear much more, and the better ones will have equalizers or band pass filters to help eliminate unwanted sounds and vibrations.

The famous "spike microphone" is a contact microphone mounted on the end of a nail or spike that is first driven into a wall so that the tip is touching the inside of the wall of the room to be listened in on.

There is no way to detect a contact microphone, but anything that causes the wall to vibrate slightly will make it difficult if not impossible for anyone to hear your conversations. A four-dollar transistor radio will do the job just fine. Remove the plastic case and tape it to the wall, near the center, with the speaker pressed directly to the surface. Cover it with anything handy to deaden the sound so it isn't a distraction and hang a picture over it. Tuned to a twenty-four-hour news station, it will be most discouraging to eavesdroppers, though they will be well-informed on current events and weather forecasts.

A microphone might be used instead of an RF transmitter for long-term surveillance in a place in which it would be difficult to use the 120-volt lighting circuit for power or a bug with large and long-lasting batteries would be difficult to hide. A carbon microphone is about a dollar at surplus stores or may be removed from an old phone for free.

The Tube

Many years ago, before telephones and electronic intercoms were invented, communicating aboard a ship was done through metal speaking tubes. The helmsman had a metal cone that he yelled into to talk to the engine-room crew, who answered in the same way.

Private homes and most small apartment buildings are wired with Romex heavy-plastic insulated cable that carries electricity to wall plugs and switches from the service or circuit breaker box. Commercial buildings and large office and apartment buildings are wired with "speaking tubes." The electrical conduit (electrical metallic tubing, or EMT) that contains the power lines will carry sound just like the speaking tubes aboard yesterday's ships.

In a large building, these tubes make up a complex maze that go up and down inside walls, elevator shafts, and air-vent shafts, and across ceilings.

The steel boxes in which two conduits join or branch off are called handi-boxes, and the ones that hold switches and wall plugs are called switch boxes. A microphone can be hidden inside one of these boxes or in the main service panel in the basement maintenance area, and it will pick up the sound that gets into the tubes. How well this works—how much can be heard and how clear it will be—depends on a number of things.

In a smaller building with fewer "conversations" in the tube and with the microphone in a box close to the target, it works quite well. If placed in the main panel in a large building, it becomes something of a party line, with dozens of people talking at the same time. Audio filtering equipment will improve the sound.

With good equipment—a high gain amplifier with filtering equipment—reception can be improved considerably.

There aren't any types of electronic equipment that will detect a microphone inside a handi-box, but defeating this method of listening is simple: fill all of the switch boxes with something that blocks the sound.

Liquid Seal-Flex will do, as will Insta-Foam aerosol packing foam. Do not use anything that absorbs moisture, such as cloth or paper, because it is a potential fire hazard. Different cities have different codes concerning this, and there is also the

National Electric Code (NEC) to be considered. Call the fire marshall or a commercial electrician for precise regulations in your area.

THE RADIO SPECTRUM

A word of explanation about frequency bands is in order before we get into RF (radio frequency) transmitters. Sound (audio), RF (radio and TV waves), light, etc., are all part of the electromagnetic spectrum, and they all vibrate at various rates or frequencies in cycles per second or hertz, the term most people use. I prefer cycles.

The audio spectrum begins with infrasonic sound, from 1 to 20 cycles per second, and then audible sound, from about 20 to 20,000 cycles per second. Above sound is ultrasonic sound, and then radio frequency (RF) or radio waves begin.

The area within the electromagnetic spectrum in which radio waves operate is called the radio spectrum. The lowest RF area starts at about 6,000 cycles. This overlaps with the audio portion, but it is still considered part of the radio spectrum, which is divided into the following groups:

- VLF—Very low frequency, from 6,000 cycles or 6 kilocycles (kc.) to 30 kc. Used mainly for marine navigation and communication.
- LF—Low frequency, from 30,000 cycles or 30 kc. to 300,000 cycles or 300 kc. per second. Also used mainly by the maritime services.
- MF—Medium frequency, from 300 kc. to 3,000 kc. or 3 megacycles or millioncycles (mc.). AM broadcasting is in this band.
- HF—High frequency, from 3 to 30 mc. It is used for all types of communications, including international shortwave broadcasting, ham radio, citizens band, law enforcement, etc.
- VHF—Very high frequency, from 30 to 300 mc. Almost all bugs transmit in this area. A few rare exceptions are microwave and the MF ones mentioned in this chapter.
- UHF—Ultrahigh frequency, from 300 to 3,000 mc. or 3 gigacycles or billioncycles (gc.). UHF television and public-service stations—police and other local government agencies that use repeaters operate from this range.
- SHF—Superhigh frequency, from 3 to 30 gc. This and EHF are the microwave bands, which are used for communications, navigation, space exploration, and satellite transmissions.
- EHF—Extremely high frequency, from 30 to 300 gc. At 300 gc., radio waves end, and infrared light begins. Then there is visible light, ultraviolet light, X rays, gamma rays, and, finally, cosmic rays from outer space.

An interesting poster-size chart, called the United States Frequency Allocations, shows the electromagnectic spectrum in detail and is available from the U.S. Government Printing Office.

RF TRANSMITTERS

Anything that transmits can be used as a bug. This will be discussed in detail a little later, but transmitters all have a few things in common: they require a microphone, an antenna, and a power source that is usually a battery. If the transmitter is hidden inside a lamp, clock, or wall plug, it can use the power lines to operate.

Remote Control

The remote-control bug is essentially the same as any other bug. It can be large or small and can be turned on or off from a remote location with a device no more complicated than a garage-door opener.

The listener can activate the remote, and if he doesn't hear anything, he can shut it off and try later. This makes the device more difficult to find and conserves the battery. One of these placed inside a large book with several D-cell batteries can last for months.

Repeater Transmitters

One of the more sophisticated types of bugs is the repeater, which uses the same principle as commercial two-way radios used by taxi companies, police agencies, etc. The mobile units send out a signal that is received by the repeater unit located on top of a mountain or other high place and is rebroadcast from this higher location at a higher power level, thus greatly increasing the range.

For example, using a portable (hand-held) radio in Santa Cruz, California, I have talked through a repeater to someone on Nob Hill in San Francisco, fifty-eight miles away.

When a repeater system is used for surveillance, a very small RF transmitter is hidden somewhere inside the area to be bugged. The small size makes it easier to hide and harder to find. The repeater used to relay its signal to the listening post can be placed in an adjoining office, inside a wall, on the roof, or on the outside of the building.

I once knew a man who managed a commercial window-washing company, who told about some of the "temporary help" occasionally provided by the owner of the company. The manager related that these people didn't know a damn thing about cleaning windows—their hands were too clean for them to be working people—and he was told that sometimes they would go up by themselves, and he was to leave them alone.

A repeater transmitter is usually hidden in a light fixture or sign where it can be connected to the power lines. Its higher output often requires more power than a battery can provide. For example, a repeater about the size of a videocassette can have a power output of as much as 30 watts, and fitted with a directional antenna, it can transmit as many miles. That kind of power would drain a car battery overnight.

A repeater system is often used in a situation in which a listening post can't be set up close to the target, such as in a rural area or an upper-middle-class neighborhood where it is not easy to rent an office or apartment and a suspicious van or other vehicle would likely be noticed and reported.

A repeater is not the easiest surveillance system to set up, and it isn't likely to be used for short-term surveillance. Access can be a problem, and it is expensive and not usually retrieved.

One of the rules in surveillance is: "If you find it, you own it." Surveillance has to be cost-effective like anything else—except perhaps for the writing of books about surveillance.

Burst Transmitter

The burst transmitter is a special (and expensive) RF device. Instead of sending a continuous signal, it stores what it hears and periodically transmits it in a fraction-of-a-second burst. This technique is used in satellite transmissions. Since it transmits for such a short period of time, it is difficult to home in on it with bug detectors.

The sound in the target area is picked up by a microphone and then converted into digital form in the same way it is described in Part II on secure phone communications.

Once in digital form, the information is stored in memory chips, the same way in which data are stored in computer memory, and when the memory is full, it is dumped to the transmitter and goes out in a burst.

Using the newer (and smaller) surface-mount chips, the burst transmitter and the batteries are about the size of two 35mm film boxes, depending on how much memory the transmitter has and how well it was designed. At this size, it can store about 10 to 15 minutes of sound.

The burst transmitter is too expensive to be used for short-term surveillance, and the size of it and its batteries (probably four penlight or larger cells) makes it harder to hide. Since it is not feasible in most circumstances for a spy to penetrate the target regularly to replace batteries, the burst transmitter is most likely inside something that plugs into the lighting circuit.

The burst transmitter is one of the most difficult bugs to detect. It can use a carbon microphone, which ultrasonic sound devices will not locate, and if it is well shielded, the nonlinear junction device (NLJD, described later) will not detect it. A piece of equipment that is effective in finding the burst transmitter is the countersurveillance monitor model CPM-700 made by REI. This device covers 50 kc. to 3 gc. and has a "time check" feature that records the time that a signal is received. I haven't used this monitor, but intelligence professionals who use it whenever they sweep for bugs swear by it. A careful physical search can also detect the present generation of burst transmitters.

The burst transmitter is not something that the average electronic technician can build easily—at least not in a small space. It requires extensive design and layout work and several circuit boards stacked atop one another. All things considered, it is very expensive to make. If one were to hire an electrical engineer to build one, it would cost several thousand dollars for the prototype.

Microwave Transmitter

A microwave bug is like other RF-type

mitters except that it transmits on microwave frequencies. One microwave engineer told me that he has seen transmitters that are one-fourth the size of a cigarette package, have an output of 100 milliwatts, and work in the 10 to 11 gc. range. Under the right conditions, 100 mw. can have a range of several blocks. I have never seen one of these. At this frequency range only a microwave receiver or a spectrum analyzer can detect the RF signal.

Microwave bugs are also highly directional. Low frequencies bend and follow the curvature of the Earth, which is called ground wave. Radio stations on low frequencies can be received thousands of miles away. Microwaves are "line of sight" and travel in a straight line, which has some effect on where they can be used.

This and their cost make them rare. Since they are inside devices, the spies who install them aren't likely to get them back. A professional will seldom even try to retrieve bugs—it is too dangerous. The following is one of the few examples of a spy being caught in the act.

> *We found a transmitter hidden inside a hot-air register while sweeping the area with a bug detector. We decided to try to draw out the person who had hidden it, so we hid a small video camera inside the room, and then disabled the bug. The next evening the camera recorded a woman opening the register to fix it. She was a temporary employee provided by an agency.*

Microwave surveillance is generally an outside method of gathering information.

Low Frequency

One of the countersurveillance experts I interviewed told me that he had never encountered a bug that operated in the LF-MF band. These transmitters are rare, but they have been used. This makes the LF band a good place for a bug to transmit because no one expects to find it there, and many bug detectors will not tune this low-frequency area.

One reason that bugs traditionally have not been used on LF is that it is an AM band. Almost all the radios that operate there—short-wave amateur radio, international broadcasting, and others—are AM. AM is much more vulnerable to static and other interference. Ever notice on your car radio that on AM you hear static and whining from nearby cars, whistling, and other noises that you do not hear on FM?

An FM bug can be built to work on high frequency (HF), but back in the early days of surveillance transmitters, most receivers would not receive FM on low frequency. So FM bugs were used on the higher band, VHF, which is almost exclusively FM, and the tradition continues.

The spectrum analyzer will find an LF bug, and there are a number of receivers that cover LF and will receive both AM and FM.

The AR-3000 scanner covers LF (and everything else). It costs about $1,000 and can be interfaced to a computer by using an optional software package. This is a good scanner, but it is sometimes in short supply because the manufacturer doesn't mass produce them. Try Scanners Unlimited in San Carlos, California, or EEB in the Washington, D.C., area.

The ICOM R-71A communications receiver tunes 100 kc. to 30 mc. and is an excellent radio. It costs about $850.

The top of the line is the ICOM R9000, which receives 100 kc. to 2 gc. in all modes (including TV) and has a built-in computer, including data/video display screen. It sells for about $4,500.

Other receivers that cover LF are by Kenwood, Yaesu, and Japan Radio, all of which are comparable. I prefer ICOM, but they are all good radios.

I know for a fact that LF bugs have been used. If you call in a team of debuggers, ask them to check for them. Or buy a receiver and check yourself, but be warned, shortwave radio listening is a fascinating and addicting hobby.

INFRARED TRANSMITTERS

Infrared bugs pick up and amplify sound just like RF bugs, but they transmit on a beam of invisible light. The principle is similar to the remote-control device for a TV set.

It is simple to build an infrared transmitter; in fact, it is one of the devices that first-year electronics students can choose as a lab exercise. Two small chips and a dozen other small components are all that you need for a finished product that is about one-inch square and that has an effective range of several hundred feet or more, depending on how it is made.

The receiver is also simple: a small filter passes through the IR light, which strikes a photocell. The variations of the light cause the photocell to generate a voltage with the same variations, which feed into a small amplifier and come out as sound.

The advantage of such a device is that it won't be found by most conventional RF bug detectors, but Capri has an optional probe that will "see" infrared light.

Its disadvantages are twofold: it has to be placed so that the beam of light is pointed out a window, and the batteries used to power it are much larger than the device itself. It normally uses TTL circuits that operate on 5 volts so it most often will use four penlight cells. Some types use CMOS, which can use a standard 9-volt battery, but this makes it easier to find during the physical search. Depending on how it is designed, the batteries may last a few days or a couple of weeks, but not months or years, thus limiting the time frame of the surveillance.

VISIBLE-LIGHT TRANSMITTERS

You are sitting in your favorite chair in the living room of your home, talking to your spouse about personal matters that you would never discuss with anyone else. Several blocks down the street, an eavesdropper has a telescope pointed at your picture window and is hearing, and tape-recording, every word you say.

This ingenious and insidious technique for eavesdropping is the most unsuspected and difficult-to-find listening device of all. It is called the light modulator.

The principle is the same as that of the IR device except that the signal is transmitted by an ordinary light bulb. The one in the table lamp beside your easy chair will do nicely. A microphone inside the lamp picks up and amplifies the sound in the room and then channels it into a circuit that causes the voltage going to the lamp to vary according to the sound from the audio amplifier. The voltage is varied only about 10 percent, so the changes in brightness are so slight you would never notice it.

The listening post can be anywhere from which the light can be seen, and with a telescope, that can be a considerable distance. Even if the curtains are closed, it will still work if enough light shows through: it is the variations in the light and not the intensity that sends the intelligence.

How well it works depends on the sensitivity of the receiver and the quality of the audio equipment used. Because there is no RF signal, bug detectors and the spectrum analyzer will miss it. By using a carbon microphone and shielding the light modulator, the operator can hide it from conventional debugging equipment.

It costs less than $50 to build a light modulator, but getting it into your target's lamp can be difficult. Installing it requires taking the lamp apart and doing some wiring that takes perhaps ten to twenty minutes. The modulating device can also be placed inside the wall socket into which the lamp is plugged.

A visible-light transmitter can be detected in at least four ways. First, the same probe for the TD-53 bug detector that detects IR will also see the variations in light.

Second, use a voltmeter to measure the voltage from the bulb socket (not the outlet) while there is some sound in the room. It should be a steady 110 to 120 volts and not vary at all. If the needle swings back and forth, you have just found a bug. Now measure the voltage from the plug to see if it is there or in the lamp.

Third, a good photographer's "spot" light meter will show any flickering.

Fourth, a physical search will uncover the device. Take the lamp apart. The lamp cord should go directly to the switch and then the socket. There should not be any kind of electrical device, printed circuit board, microphone, small wires, etc., in the lamp. Then look inside the switchbox (the "universal hiding place") for the types of extraneous devices, wires, etc.

The visible-light transmitter is a clever device. Beware of peddlers crying, "New lamps for old."

WIRELESS INTERCOMS

Sometimes called subcarrier transceivers, wireless intercoms are like conventional intercoms, except that the signals are sent through power lines. Some wireless baby monitors use this technique.

The range of subcarrier devices is limited to those power lines that are from the same line transformer, the kind you see on some telephone poles. They step from 12,000-21,000 volts down to 120 volts used in lighting circuits. Because of the characteristics of these transformers, the signals can't get through them and into the next transformer and the lighting circuits it feeds.

One such transformer can supply approximately twenty single-family houses, one hundred apartments, or a medium-size office building—which tells you approximately from how far away it is effective.

The signal from a subcarrier device can be detected by a device made for this purpose, such as the one available from Capri Electronics. The microphone can usually be detected with ultrasonic sound.

If you have one of these in your home, keep in mind that others can listen in on it from other apartments or down the street . . .

• • •

With inside devices, there are trade-offs. A wireless microphone can be inexpensive, but it has a short range and battery life. The burst transmitter is harder to find with surveillance gear, but it is larger and more expensive. A repeater has almost unlimited range, but it is expensive and can be difficult to install. You must consider all these things before deciding upon the type of bug to use. You will understand this better after reading the section on physical searches for surveillance devices in Part III.

PART II

TELEPHONE SURVEILLANCE

AN OVERVIEW

Never assume that your telephone conversations are secure. Even if you aren't being bugged, what about the person on the other end of the line?

There are ten basic methods of intercepting phone conversations:

1. Direct listening wiretaps
2. Remote listening wiretaps
3. Down-line taps
4. SO and REMOBS
5. Cordless phone monitoring
6. Cellular phone monitoring
7. Answering machine hacking
8. Voice mail hacking
9. Microwave and satellite interception
10. Phone tricks

DIRECT LISTENING WIRE TAPS

The first method is just like the hidden microphone in the preceding section, except that the wires are connected to a phone line and strung to the listening post, or existing wires are used.

At the listening post, the wiretapper might use a lineman's test set, an ordinary telephone, or a "listen down the line" amplifier, but most likely he will use a modified tape recorder. Experienced spies always tape-record what they hear.

The recorder will probably have a "drop-out" relay that interfaces it to the phone line. This device turns the recorder on when the phone is being used and turns it off again when the phone is hung up. Drop-out relays are available from many places, such as Sherwood Communications.

In a private home, the listening post can be in the backyard, or the wire can lead across a fence to a neighbor's yard (or house). It can also be inside the house, using the tape recorder and drop-out relay, as was done in one case with which I am familiar.

The whole family was a bunch of thieves. They burglarized people's homes, stole anything they could from where they worked—even if they had no use for it—and at school Steve took everything he could get his hands on. Steve asked another student to share a house with him, his wife, and brothers. The student agreed, and they rented a large home near the campus. After a while, he realized what Steve and his family were really like and became concerned about his computer and electronic equipment.

After thinking about it for a long time, he decided to bug them and installed a Marantz tape recorder and a drop-out relay on the phone line they shared.

It wasn't long before he found out that Steve and one of his brothers were planning to fake a burglary just after graduation and steal all his expensive equipment and take it with them in a rented moving truck when they moved back to their family home in Virginia.

The roommate and a friend decided to set up the thieves. They hid in the friend's van in front of the house and photographed them in the act of loading the stuff into the rented truck. Caught in the act, they were given a choice: load up their belongings, *leave town and don't come back, or be arrested. They headed south.*

The direct method is the same in private homes and office or apartment buildings, but the wiretaps are sometimes wired in different ways.

Each unit may have its own small four-wire cable, like those used in private homes, or there may be a larger cable with wires for twenty-five, fifty, or one hundred phones that loops through the building from the main phone line connection panel, sometimes called a "sixty-six block."

In older buildings, this block may be on the basement wall where anyone can access it. Newer buildings usually have the phone wiring in a secured area called a distribution closet. At each unit, the small four-wire cable branches off from the large one, enters through a small hole drilled in the wall, and is connected to the plastic modular jack, or to an opening in the wall covered with a plastic plate (the same size as a wall plug or light switch) that has the modular jack built into it.

If multiline cable is used, then anyone can tap into any of the lines inside it. To select a particular line, the tapper has to know which it is by the colors of the wires inside the cable (more on this in Part III).

REMOTE LISTENING WIRETAPS: TYPES OF RF PHONE BUGS

An RF phone bug is a transmitter, the same as in the preceding example except that it is connected to the telephone line instead of a microphone. Obviously, it will not pick up the sounds inside the room where it is placed, only what is spoken over the telephone.

There are several ways to use an RF phone bug. It may be direct or inductive. A direct tap is wired to the phone line and may be series or parallel. The series usually draws its power from the phone line, and the parallel usually has a battery to provide power.

An inductive tap uses a coil of wire placed close to a phone or the phone line and picks up the conversation from the electromagnetic field that radiates from the phone or the line. And again, as with direct listen, the wiretapper has to know which line to tap.

If the target is a private home, then it's obvious which pair to use, but as before, the spies have to get into the house, backyard, or basement to tap the line.

In old apartment buildings, especially big houses that have been converted into apartments, the phone wires are strung all over the basement area. New wires, old wires, and ancient wires are everywhere. This is a wiretapper's dream. Access is usually easy, the phone lines are often tagged with the apartment number, and the places in which to tap the line are almost unlimited. There is plenty of space for a large (and long-lasting) battery, and often the doorbell wires are right beside the phone wires, which is like manna from heaven: the listener taps the doorbell line, changes it to DC, and uses it to power the bug.

A bug in such a place can accommodate a very powerful transmitter, and there is plenty of space for a long antenna so the range is virtually unlimited —literally miles.

Louis, an easygoing type of guy, was well-liked by everyone, including the employees at the furniture store he owned. Louis had been dating a girl named Cindy for several months, and although he hadn't mentioned it to her yet, he was thinking they might eventually get married. One evening he was at a cocktail lounge, wishing he were with Cindy, who had told him she would be out of town for a few days visiting her family. After a while, Louis left the bar, and as he was getting into his car, he saw Cindy with another man going in.

Hurt and shaken, Louis sat there for a while, thinking, and then went home. Cindy had told Louis that he was the only man she was seeing, and he was upset by her lying as well as the fact that he had extended her more than three thousand dollars in credit for new furniture.

The next day when he confronted her, she tried to lie her way out of it by saying he was mistaken, that she hadn't been at the bar. She finally broke down and admitted that she had, but she told him it was "too bad because there isn't anything you can do about it." When he asked if she was going to pay for the furniture, she replied, "You gave it to me, and I don't owe you anything."

Louis felt sick inside. He was hurt and angry, and *he decided to get even. He had some knowledge of electronics from his days in the navy, so he built a large transmitter from a radio using plans obtained from an old issue of* Popular Electronics. *He installed the transmitter in the basement of her apartment building.*

For three weeks people in the neighborhood of the medium-size city in Michigan listened to her lie to and use half a dozen men, telling each that he was the only one in her life, and then bragging to her girlfriends about all the money and gifts she had conned from them.

When someone finally told her about what was happening, she freaked out and decided (for real) to go and stay with her family. A neighbor saw her load some things into a station wagon, and she never came back to the old neighborhood. Louis got his furniture back, but the hurt and bitterness stayed with him a long time.

We think Cindy deserved what she got, and we sympathize with Louis, but this still does not justify what he did. He was not defending himself; he was getting even. And what about the right to privacy of the many people to whom Cindy talked?

Line-Powered Remote Wiretaps

As the name implies, such phone bugs receive power from the voltage on the phone lines, which typically is 48 volts. The power of this type is low compared to other types, because of the load it places on the line. If the load is too great, the bug will be detected automatically by the telco maintenance equipment.

Line-powered bugs are in all other respects the same as other types of RF phone bugs: they are attached to the line, and they transmit what is being said on the line to a nearby receiver.

Drop-In Remote Wiretaps

The drop-in is an ordinary carbon telephone microphone that has a small line-powered bug built into it. Because it uses a small line-powered bug, the drop-in has a limited range, approximately one hundred feet.

It was invented back in the 1960s when almost all telephones were built by Western Electric and used the same type of mouthpiece. In just a few seconds, the Bakelite cap could be unscrewed and the replacement dropped in, hence the name.

The handset (receiver) of many of today's phones are molded in two parts and screwed together, but if you have a phone with the screw-off caps and you suspect such a device, you can just replace the microphone or the whole phone. Since the drop-in is line-powered, it will not work once it is removed or the phone is disconnected from the line.

Series and Parallel

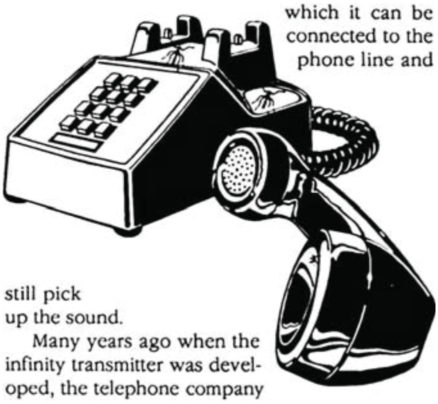
These two are also two variations of the basic RF phone bug. The bug has two wires coming out of it. With the parallel bug, the two wires are just spliced across the two phone line wires. With a series bug, one of the phone wires is cut, and the two open ends go to the bug's two wires. A parallel bug is usually battery-powered, and the series device is usually line-powered—usually, but not always.

There is a difference in how they affect the line, which will be described in the section in Part III on finding phone bugs.

The Infinity Transmitter

The infinity transmitter is not really a transmitter like the RF devices described above. It is a remote-controlled device used to listen in on the room where the target phone is located.

The infinity device is wired inside the target phone (or some versions have a built-in microphone and are hidden somewhere else in the area) from which it can be connected to the phone line and still pick up the sound.



Many years ago when the infinity transmitter was developed, the telephone company used mechanical stepping switches or relays (crossbars) to connect one line to another. If you called a number, the switches or relays would make an electrical connection between your line and the one you called as soon as you dialed the last number.

Once the connection was made, the called phone was turned on, and the mouthpiece or built-in microphone was hot. This is called a hook switch bypass. The listener would then send a tone down the line that would stop the phone from ringing. This was originally done with a harmonica, and the device was called a harmonica bug.

The Electronic Switching System (ESS) now used by the telco will not connect the two lines together until the called line answers, so infinity transmitters that worked with the crossbar switching systems won't work with the ESS. Other types will.

The new types intercept and store the voltage that causes a phone to ring for a fraction of a second and then place a resistance across the line that simulates its answering.

In this short period of time, it listens for its activation tone, like the harmonica note used with the old type. If it hears this tone, the phone is answered, and the microphone becomes hot. If not, it releases the stored ring voltage, and the phone rings as usual. The bypass can be deactivated by sending another tone, and the phone will then function normally.

Infinity transmitters that work on the ESS systems are hard to come by; they are not likely to be found in "spy shops" or mail-order catalogs.

Another device that is similar to the infinity transmitter is advertised as a "burglar alarm" or "telemonitor." If placed on a phone line, it will "answer" the line and activate its self-contained microphone, but it will not prevent the phones on that line from ringing. If the listener were to disable the ringers in the phones on the target line, this device would then work as an infinity transmitter and prevent the phones from ringing, but before long someone would start to wonder why no one was calling him or her anymore.

These devices sell for $150 to $200, which is too much for most people to spend on something that isn't likely to work for more than a day or so.

Telemonitors are intended to be used with a dedicated line that has no phones on it. An example of the telemonitor is the Panasonic KX-T2432 Auto-Logic remote-controlled answering machine, which has a function called "answer back."

To use it, you call from any phone, and when it answers, punch in a code number from the Touch-tone pad and the built-in microphone will turn on, allowing you to hear what is being said in the room where the phone is placed. It stays on for only thirty seconds, but it demonstrates how telemonitors work.

Telemonitors are legal if not used to listen to someone without his or her knowledge and are available from Sherwood.

Subcarrier Extensions

A subcarrier extension system couples a phone line to the AC power line so that an extension phone can be plugged into any AC wall outlet using a small adapter. The principle is the same as wireless intercoms and baby monitors.

Some companies that sell these systems imply that the signal can't be received outside your own home. This is untrue, as you learned in the section on wireless intercoms. If you have such a system, keep this in mind, or better yet, take it back to the place you bought it from and demand your money back. Tell the clerk that you were a victim of false advertising.

A subcarrier extension system can be used for surveillance by hiding it somewhere in the target area from which both power and phone lines can be accessed—in the basement of an apartment building or in your garage if you have an extension phone there.

Like wireless intercoms, the CD-01 subcarrier detector from Capri Electronics will find a subcarrier extension.

DOWN-LINE TAPS

A down-line tap is generally defined as any tap that is outside the area over which one has control or to which one has access to—one that is off the premises. This could be outside of a house or office building or anywhere from the telephone pole in an alley to inside the telco's underground junction points. A down-line tap can be either direct or remote. Down-line taps are uncommon for a number of reasons, which are explained in Part III on searching phone lines.

REMOBS EAVESDROPPING

REMOBS stands for Remote Observance. REMOBS is a way to listen in on a phone line from another (remote) phone line. If your phone were tapped under a court order, the telco could then program its computer to tie it to a second (REMOBS) line, which goes directly to the agency that obtained the order.

At the offices of that agency, the listeners would set up their tape recorders and whatever else they do in these situations. They probably have dedicated lines for this purpose. Of course, I do not know that they do, but since it is a legal tap, it is doubtful that two agents and three tape recorders would take up residence in a cramped distribution closet. (This makes it hard to send out for a pizza.) This is one example of REMOBS.

The following is the true account of something that happened that leads me to think that there is another way to use REMOBS.

About two years ago, when I first heard of remote observance, I tried to learn more about it. All I knew at the time, actually what I had heard rather than knew, was what I stated above: that it is a way to tap one phone from another.

I started by calling Pacific Bell. Everyone I talked to said he never heard of it. I expected that. I wandered around looking for telco trucks and pestered some of the workers with questions, but everyone said he didn't know what it was. Some of them were lying—I can't prove it, but one can sometimes tell when someone is being untruthful.

Then I left messages on a number of computer bulletin boards asking anyone who knew anything about REMOBS to call; the message also stated that there were two lines to use for a demonstration. I gave the number of line one, but not line two, which was billed to the first. Both numbers were unlisted and unpublished.

A few weeks later I received a call from someone who did not give a name. He said he could demonstrate REMOBS. He asked me to make a call on the second line. Since I didn't want to make anyone else a party to this, I called a number that I figured would put me on hold for a while. I called Pacific Bell.

A few seconds after the call was answered and the synthesized voice was saying something about the high volume of calls, the caller came in on line two, while he was still on line one, and there was no "click." I started to ask how he did it, but he cut me off and offered a second demonstration. I was told to call a bulletin board system (BBS).

The line went silent, but the dial tone did not come back on. I pushed the hook switch and got the dial tone back, hung up, and called a computer BBS, and about a minute after I logged on, the anonymous caller—still on line one—started reading back everything I was typing on the computer as I typed it. I tried to get him to explain, but he said he had to go. I never heard from him again.

Have you ever picked up your phone to make a call and found that someone else was on the line trying to make a call? Have you ever called a number that wouldn't ring, and then heard people talking in the background?

Some observations:

- I had a voltmeter on both lines to monitor the line voltage. It is set by the telco at 48 volts, and while it varies depending on a number of things, it should be between 46 and 52. When the phone is "off hook," it drops to about 12 volts, and if a second phone is picked up, it drops a little lower. When the caller came in on line two, it dropped from 12 to 9 volts.
- I didn't tell the anonymous caller the number of the second line. In the first demo, I didn't tell him whom I was calling from line two. In the second demo, I didn't tell him the number or the name of the computer BBS I called. The system has only one incoming line.
- There are ways of getting unlisted numbers. That part was no surprise, but somehow he tapped into line two both by voice and computer.
- Some people have suggested that this was done by a telco employee who was in the switching office (SO) at the time. That is one possibility.
- A countersurveillance expert I discussed this with suggested that he tapped the line into the apartment building. That's the first thing I checked. The SPSP boxes where our lines came in were secured in such a way that I would know if they had been opened. There is no other place they could have been tapped without removing the insulation

from and splicing a wire to the line. This had not been done.

Pacific Bell will deny that what I have described is possible, but I am not convinced. Every phone line in the telco system goes into, and is controlled by, its mainframe computer system, which is, has to be, capable of connecting any line to any other line. With the right access codes, passwords, and the like, it seems logical that someone could use REMOBS.

All I know is what happened.

CORDLESS TELEPHONES

Cordless telephones operate under provisions of the FCC "low power" laws, which limit them to 100 milliwatts (1/10 watt) power. They are advertised as having a range of 100 feet, 200 feet, etc. This is true with the antennas that the base and handset use and the sensitivity of the receivers.

However, a good scanner with an antenna on top of a house or building can pick up cordless phones much further away. Depending on terrain and obstructions, range can be from several blocks to more than a mile.

Practically every scanner made, from the cheapest ten-channel available for $50 in pawn shops to the top-of-the-line models like the AR-3000, receives cordless phone frequencies. Cordless phones have ten channels with separate frequencies for base and handset. These frequencies for base and handset respectively are:

CHANNEL 01	46.610	49.670
CHANNEL 02	46.630	49.845
CHANNEL 03	46.670	49.860
CHANNEL 04	46.710	49.770
CHANNEL 05	46.730	49.875
CHANNEL 06	46.770	49.830
CHANNEL 07	46.830	49.890
CHANNEL 08	46.870	49.930
CHANNEL 09	46.930	49.990
CHANNEL 10	46.970	49.970

Some older cordless phones operate on other frequencies. They are listed in Appendix D.

Hundreds of thousands of scanners have been sold in the United States, so keep this in mind when you use a cordless phone. Also be suspicious if some mail-order company sends you one as a "marketing test" or whatever. This has been done . . .

CELLULAR TELEPHONES

In the section on surveillance law, I mentioned that there is a law that allows people to listen to some types of radio-telephone conversations but not others. This law is the Electronic Communications Privacy Act (ECPA), which prohibits monitoring both cordless and cellular phones. Part of this law has been reversed by the U.S. Supreme Court, which, as I understand it, states that "no reasonable expectation of privacy" exists on cordless phone frequencies, so apparently they can be monitored legally.

The Omnibus Crime Control and Safe Streets Act of 1968 doesn't seem to cover cordless phones, either, but I don't know for sure. Consult a lawyer rather than take my word for this.

Listening to cellular radio is still against the law (ECPA). Why one is legal and the other is not, I do not understand. They both use a duplex two-way radio, both are connected to phone lines at one end (or both), the frequencies of both are public-domain information, and scanners that can receive both without being modified are on the market. According to the law, a person using a cellular phone has a "reasonable expectation of privacy." In reality, that person does not.

Some salespeople in cellular phone stores will try to convince you otherwise. I went into one store in Chicago, pretending to want to buy a phone, and told a salesperson that I was concerned about people listening in with scanners and asked if this was possible.

"Certainly not," he replied. "By law, scanners aren't allowed to be sold in this country if they can receive 'our' frequencies, and they are kept confidential."

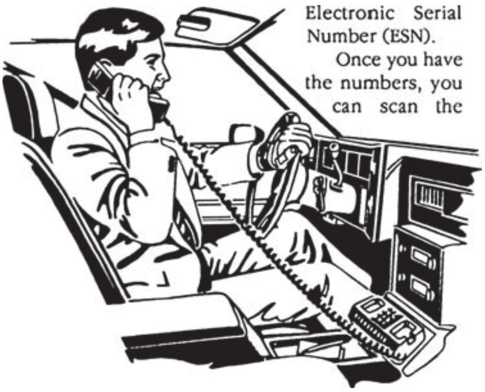
With the righteous indignation of confronted liars, he continued, "Even if someone had these frequencies, he couldn't hear anyone for more than a few seconds because the channels change every few seconds." None of what he said is true.

Whereas cordless phones operate on only one of 10 channels, cellular phones have 820 channels; each of the two vendors uses 410 of them. As the phone moves from one area to another, it changes from one channel to another. This makes it harder to stay with or track any one conversation. It is difficult, but far from impossible. Cellular telephones have greater range, as the antennas are usually on top of towers or tall buildings, and tracking requires only a good scanner with at least 200 memory channels (400 is better), a good outside antenna, and the expertise to program it effectively.

With such a scanner it is possible to track the same conversation throughout most of a large city and some suburban areas, and if the phone stays in one place, the scanner won't change channels. Some conversations have continued for hours without the scanner's ever-changing channels.

It is not possible to just dial up a particular cellular phone with a scanner, but if you know that the caller is in a certain area and recognize the voice, you can find him if he stays on the air for at least five minutes. It is also easy to follow the vehicle as he drives and to stay with the conversation, as described in Appendix F.

To tap into a given phone or to be able to tell whenever that particular phone goes on the air, you need a system access monitor (SAM). A portable SAM that is close to a cellular phone will 1) receive the signals it sends (called Capture Voice Channel Assignment), 2) display on the front panel, and 3) store for later printing all of the information in the phone's NAM (number assignment module), including, among others, the Mobile Identification Number (MIN) and Electronic Serial Number (ESN). Once you have the numbers, you can scan the cellular system data channels with the SAM and look for them. You can also monitor the single control channel used for incoming calls and tell when a call is placed to that phone. SAMs sell for $1,200 to $1,400.



With some cellular phones, it is possible to duplicate these numbers and burn them into the NAM chip of another phone. It works on the pirated number just like the real phone.

I have been told that vendors have added some new security methods to prevent this. Check with a local vendor or the manufacturer. Someone could run up a large bill on your account, and you wouldn't know it until the next statement came.

Whenever you use your cellular phone, remember that there is a good chance that someone, somewhere, is listening.

For more information on how the cellular system works, see the article on how cellular radio works in Appendix F.

Some scanners and communications receivers receive the cellular bands without modification, including the ICOM R7000 and R9000 receivers and the AR-1000 and AR-3000 scanners. Others are easily modified. Details on how to do this are in Appendix G.

ANSWERING MACHINES

If I were to call your phone number and get an answering machine that has the remote-control feature, I could listen to, record, and erase your recorded messages if I wanted to.

Using a computer program that generates the pairs of DTMF (Dual Tone, Multifrequency) Touchtone frequencies, I called my machine from my second line, and although it took five attempts, I was able to break into it. Written in BASIC, what this program does is to generate all of the tones sequentially from 000 to 999, which can then be tape-recorded, and used from a pay phone.

"Phreaketh thee never phrom thine own phone phor surely thou wilt be phound and thy computer taken phrom thee."

From the Hacker's Ten Commandments.

Touchtones are actually different pairs of frequencies for each of the twelve keys. In addition to these twelve, there are four other tones that the Touchtone pad can generate: A, B, C, and D in the chart. These are not included in standard telephones but are used by the military Autovon system. They are Flash, Immediate, Priority, and Routine.

These frequencies, in cycles per second, are:

KEY	FREQ1	FREQ2	KEY	FREQ1	FREQ2
1	697	1209	4	770	1209
2	697	1336	5	770	1336
3	697	1477	6	770	1477
A	697	1633	B	770	1633
7	852	1209	•	941	1209
8	852	1336	0	941	1336
9	852	1477	#	941	1477
C	852	1633	D	941	1633

The attempt to access the remote message playback has to be made after the machine seizes (answers) the line and before the incoming message recording begins, or the generated tones will be on the message playback tape, which will alert the owner that someone is trying to access his machine.

A machine that uses four digits or includes the • and # keys provides much more security—enough to stop all but the most determined hacker. I don't know of any models that has these features now, but sooner or later they will be on the market.

Meanwhile, you might consider making your access code of three random numbers. Don't use the first three digits of your phone number, address, or area or Zip Codes. These are the first combinations an experienced hacker, using a battery-operated Touchtone pad (pocket dialer), will try. "Don't leave home without it," another one of the hacker's ten commandments, refers to the pocket dialer.

VOICE MAILBOXES

Hacking voice mailboxes works in the same basic way as breaking into answering machines. Some computer BBS offer free programs made specifically for hacking voice mail (VM) passwords.

If a hacker has a VM number and he wants to get into its private boxes, he will call it late at night when it isn't busy and activate the program, which will then start dialing password combinations either randomly or sequentially until it opens one and then store that number for later use.

Some VM systems use a four-digit or longer password. Four digits create 10,000 possible combinations, which take a great deal of time to break.

Better systems will disconnect anyone that makes three incorrect attempts at a password. The hacker may hit on a password that is being used just by chance, but this auto-disconnect feature makes it much more difficult and provides more security against hackers.

Voice-mail numbers can be learned by using computers, something like in the movie *War Games*, but with improvements. The telco computer is programmed to look for someone who is dialing many sequential numbers, and when it detects this, it prints the information out on a line printer and alerts the telco security personnel.

The improved system is set to work on a particular exchange and then will dial the last four numbers at random so it does not alert the telco system. It keeps a record of the calls made and the results, such as no answer, disconnect, or the presence of a voice-mail system. Then the password hacking program is used.

If you use voice mail, find out how much security it provides. Does it disconnect a hacker after a certain number of incorrect attempts? Does it keep a record of when it has been accessed? If so, check the record now and then if you have reason to believe someone is trying to get into it.

Accelerated Information, Inc., is a nationwide voice-mail system that has an interesting security feature: if you make a mistake and enter your access code incorrectly, then the computer requires that you enter it again twice. It also will make a record of any incorrect attempts and will advise you automatically, so you will know if someone has been trying to get into your message base.

If you can use a longer password, then do so, remembering to make it of random numbers and not a number someone might assume you would use, as mentioned above. Five digits generate 100,000 possible combinations. One would have to be very determined and spend many hours to break such a password.

A second method of hacking voice mail is to listen to cellular phone frequencies. If someone has your voice mail number and knows you use a cellular phone, he can use a scanner to track your conversation and wait for you to use the VM system. When you punch in the password, the scanner hears the DTMF tones, and a Touchtone decoder connected to the scanner's speaker jack will display them on the panel LEDs. Such a decoder is available commercially, but it is not cheap.

Anyone who is familiar with digital electronics can build a decoder. It is not at all complicated, and the parts cost less than $50. Plans for a decoder can be found in the public library in the electronics section.

An easier method is to use a pager. Tape-record the tones from the scanner, call your pager number, play them into the phone, and the pager will display the number.

Obviously, this technique will also capture calling-card numbers, so consider using direct dial on your cellular phone, and never use or give out your calling-card number over the cellular radio system.

SATELLITE AND MICROWAVE INTERCEPTION

Satellite or microwave interception of phone calls doesn't really apply to most of us, but it is interesting to read about.

Satellite Interception

Satellite phone calls can be intercepted by using a standard TV earth station or a TVRO receiver and a four-foot dish. The satellite receiver's base-band output feeds into a short-wave receiver or scanner antenna connector, and the listener can tune across the band and hear hundreds of phone conversations. However, there is no way to tune in on a particular conversation; it's a matter of hearing whatever is there. Much of the conversation is from big businesses that have branch offices across the country, such as fast-food chains and car-rental agencies, and is very boring, but television stations, newspapers, and wire services use satellite transmissions, and what they have to say can be far from boring. Consider CNN's coverage of the war in the Middle East. There were videotapes of the news crews using a portable four-foot dish antenna to communicate with the networks. With an earth station and scanner described above, you might have heard all of what they were saying and not just what they were allowed to report.

This process is detailed in *The Hidden Signals on Satellite TV* by Harrington and Cooper, published by Howard Sams & Company.

Microwave Listening

Not so many years ago, all long-distance phone calls traveled over wires strung on telephone poles, but today most of them are relayed by microwave towers. Anyone in the path of these directional microwave signals who has the right equipment can intercept these calls. The receivers are expensive (tens of thousands of dollars), complex, and require sophisticated "demultiplexing" circuits.

Federal intelligence agencies have this equipment and can—and do—listen to the phone conversations that are transmitted over the vast network of microwave relay stations. Overseas calls are routinely listened to by U.S. government agencies—national security considerations again.

The Soviets have the same technology, and one of their embassies just happens to be directly in the path of one of these relay towers. Das vadanya, Ivan . . .

PHONE TRICKS

If someone were to call for an executive of a big company to order a change in phone service, such as a new private line or extension, no one would necessarily know about it until the next bill came,

and even then although things go through channels, it could take some time before he found out that it had been ordered it.

Some big companies have offices in several locations. One person might have an office in two different buildings and have a private line in one and an extension to that line in the other. This is called an outside extension.

If someone knows your private number, he could call the telco and order an outside extension installed in a new property he had "just acquired." A spy could do this and tap your line without having to leave his home. Of course, there is a record of the location of the extension, but it could be a small apartment rented under a phony name.

• • •

Some phones have hook switches that only need to move a quarter inch or so to turn them on. Placing a small square of rubber or plastic under the receiver can hold the line open.

If someone were alone in your office for even a few seconds, he could call a prearranged number and prop the phone receiver up to keep the line open. You probably wouldn't notice it until the next time you used the phone. If he is lucky with his timing, the intruder might be able to listen in on a meeting between you and an important client. The sound will be muffled, but a good amplifier and other audio gear will improve it enough for him to make out what is being said.

Below is another phone trick that sometimes works.

You are Mr. A., the CEO of a medium-size electronics company that makes AC widgets, which is in the process of merging with a company that makes DC widgets. There remain many details to be worked out, and you and the CEO of the other company spend a great deal of time on the phone.

While you are in the middle of doing sixteen other things, your intercom line buzzes. Your secretary tells you she has Mr. B. from the other widget company on the line. You pick up the phone and start talking.

What you don't know is that you are talking to each other through the telephone system of Mr. C., a professional industrial spy who has been hired to get intelligence about the merger. Mr. C. has a tape recorder attached to the phone, and everything you say is being recorded.

What Mr. C. did was to call your office and have his secretary tell your receptionist that she has Mr. B. on the line. Then she called Mr. B. and told his receptionist that she has you on the line. So both of you pick up the phone and start talking, never stopping to think about who called whom.

This has been known to work.

SECURE PHONE COMMUNICATIONS

The above examples provide information on the methods that can be used for phone surveillance. In Part III on finding bugs and wiretaps, there is a chapter devoted to searching phone lines. This information will enable a person to make his inside wiring secure from electronic intrusion—in some cases 100-percent secure; in others, very close to that. Meanwhile, there are other ways of making communications more secure.

The first is to stop using your home or office phone for confidential conversations, i.e., for anything that is important enough to someone to cause him to arrange a phone tap.

Instead, for confidential conversations use a pay phone selected at random and do not use the same one all the time. A quiet place to use a pay phone is hard to find in a large urban area; usually the best place is in the lobby of a large hotel that has a number of phones in a small, quiet room.

If you were in the habit of using such a phone, someone who was following you would know. Real spy stuff, this . . . So what a professional eavesdropper can do is use one of the other phones there, call a prearranged number, then place a small plastic block on the hook switch to hold the line open (as in the preceding example), replace the receiver, and hang an "Out of Order" sign on it. The person at the other end can easily hear you using the phone next to it. Sound farfetched? It's an old trick.

For maximum secrecy, communicate in person or use a computer and a data-encryption program when possible. You can use computer bulletin boards for storing messages to be encrypted.

Phone-scrambling equipment is available that increases the privacy of phone conversations to various levels of security, but they must be used in pairs: the person to whom you are talking has to have the same type and use the same prearranged code as you.

There are solutions to this problem. One readily available, fairly inexpensive device is the phase-inversion device that scrambles sound in such a way that it sounds a little like Donald Duck. This device will keep the average person from knowing what you are saying, but a pro can defeat it. These devices are available from mail-order companies.

Another option is the digital encrypting systems that provide various levels of security, depending on the type of system. The Digital Voice Protection (DVP) system from Motorola provides a high level of security. The following is a semitechnical explanation of how it and the other digital methods work.

First, the sound of your voice goes through a "splatter" or band-pass filter, which 'clips' the bandwidth of the sound. This limits the frequency range and makes it easier to process, similar to the telco system that limits sound from 300 to 3,000 cycles, compared to normal hearing of about 40 to 15,000 cycles.

Then the sound is "sampled." An electronic gate is opened for about 1/10,000 of a second, and the frequency of the sound that passes through the gate is measured. This is the same method used in compact disc (CD) music systems, but where a CD samples the sound 20,000 times a second, the DVP rate is about 7,000. It is less because the bandwidth is narrower.

Each of these samples is then turned into a binary number, a series of ones and zeros, by an integrated circuit called an analog-to-digital converter. Once the sound has been converted to numbers, it is a simple task to scramble these numbers. This is done by both substitution and transposition. The process is simple, but the result is complicated.

The resulting signal, which sounds like the hiss of an FM radio tuned off-station, is sent over the line to the other phone where the process is reversed. The binary numbers are decoded and then fed into a digital-to-analog converter and become your voice again.

Another method of scrambling, called SVX, uses the Data Encryption Standard (DES) developed by IBM for the federal government. It is essentially the same as DVP, except that the algorithm used to scramble the binary numbers is much more complex.

To use the SVX or DVP system, each phone is programmed with the key, using a device that interfaces with a computer (a small PC) called the "keyloader," which has a series of buttons on the front panel that are labeled in hexadecimal, a method of counting based on the number 16 instead of 10. Like the other methods, SVX and DVP require that both parties have the same type of scrambler.

The ultrasecure system that GTE Mobilnet has installed in its cellular system will one day be available to the public, and this will keep your communications secure from anyone except the federal government and other law-enforcement agencies, and possibly some others, but even with the key, a sophisticated computer system that is beyond the means of most eavesdroppers is required to unscramble the transmissions. I don't know when it will be available; some people at GTE won't even admit that it exists. Perhaps if enough people put enough pressure on the feds and GTE it will be soon.

Cellular One is also working on such a system, but the company won't discuss it other than to say it is "on the drawing board."

PART III

FINDING BUGS & WIRETAPS

AN OVERVIEW

Part three is about how to find inside surveillance devices and how to deal with them if any are found. It is divided into two parts: the physical and the electronic search. Electronic searches require equipment that can be expensive and some of which requires experience to use. They are detailed in this part.

The physical search you can do yourself, and if done correctly, it will find practically every type of inside listening device that exists. However, while there is a considerable amount of useful information here, just reading it will not make you an instant expert. There is always the chance you might miss something a pro would have found. If you have the funds, I strongly recommend that you hire a pro.

CONDUCTING A PHYSICAL SEARCH

The examples presented below, as well as the others in the chapters on electronic searches and securing an area, are intended as a guide rather than a complete list. Use your imagination and knowledge of the area to be searched to supplement the list.

First, keep a record of the search and other pertinent information. Make an exploded drawing of the room (as shown in the illustration on page 30) and list all the possible hazards—places a listening device could be hidden. The illustration lists some of them as examples.

Another idea is to photograph the area to be searched; this is particularly important if it is a business with many small offices, a conference room, etc. During the next search, you can compare the photographs to the room to see if anything has been brought into the room(s) that could hide a bug, such as a new plant, picture, books, furniture, and other such places.

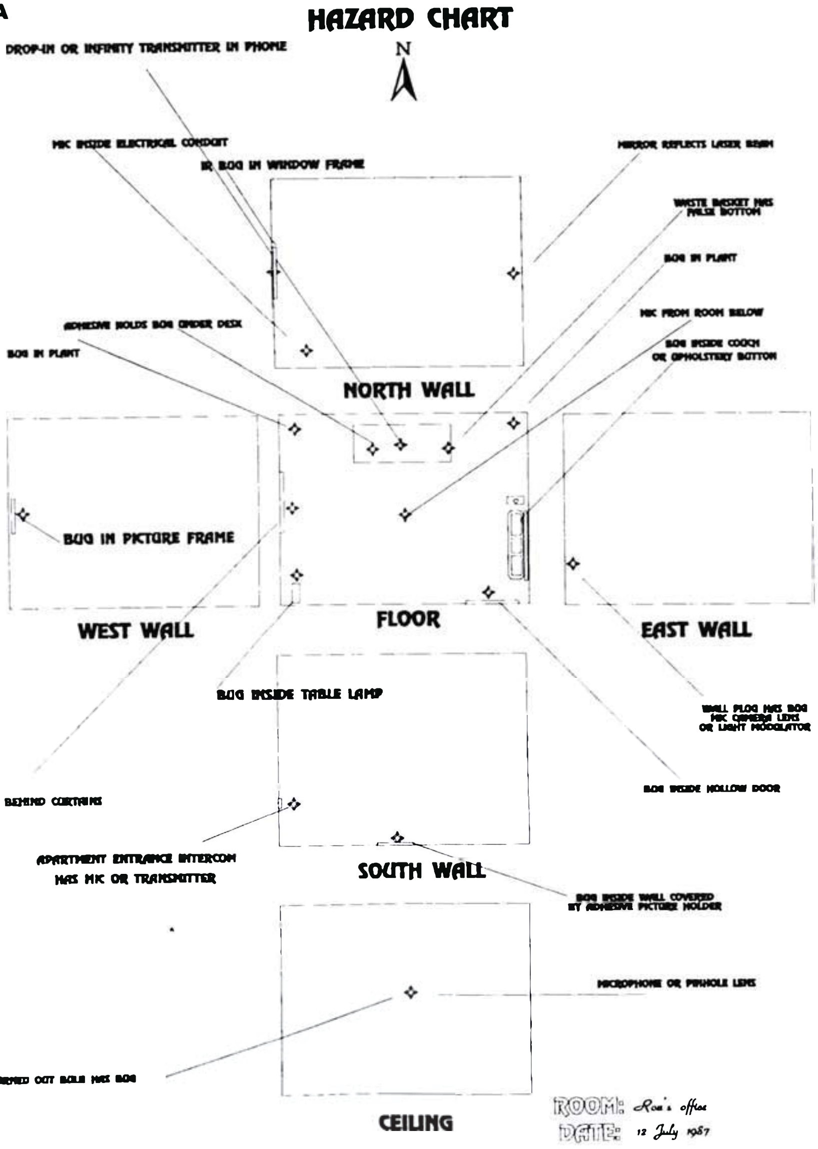
Earlier, I suggested that if there is a listening device present, the person on the other end may hear you making the search. Pulling drawers from desks, moving pictures, or checking lamps could give you away. It is better that the listener doesn't know that you are looking, and there are ways of covering the sounds made in the search.

One way is a two-phased search: the silent search and the disguised search. Take a long look at the area and see what can be inspected without making any suspicious noises, make notes in the file, and then do that part first. For a large area with a lot of furniture, bookshelves, and office equipment, consider using small colored inventory labels to mark what has been secured as you cross it off the list.

Some useful tools for a search are pliers, screwdrivers, a magnifying glass, a dentist's mirror, a ruler to measure things for false bottoms or hidden compartments, and a good flashlight. The Mag-Lite and Mini Mag-Lite work well because the beam can be adjusted from wide to narrow, but anything with a very bright beam will do.

Keep in mind what you learned earlier about where devices can be hidden and what to look for—antennas, wires, etc. Before you start, here are some ideas on what to look for.

59A


HAZARD CHART
N
DROP-IN OR INFINITY TRANSMITTER IN PHONE
MIC INSIDE ELECTRICAL CONDUIT
IR BUG IN WINDOW FRAME
MIRROR REFLECTS LASER BEAM
WASTE BASKET HAS FALSE BOTTOM
BUG IN PLANT
ADHESIVE HOLDS BUG UNDER DESK
BUG IN PLANT
MIC FROM ROOM BELOW
BUG INSIDE COUCH OR UPHOLSTERY BOTTOM
NORTH WALL
BUG IN PICTURE FRAME
WEST WALL
FLOOR
EAST WALL
BUG INSIDE TABLE LAMP
WALL PLUG HAS BUG MIC CAMERA LENS OR LIGHT MODULATOR
BUG BEHIND CURTAINS
BUG INSIDE HOLLOW DOOR
APARTMENT ENTRANCE INTERCOM HAS MIC OR TRANSMITTER
SOUTH WALL
BUG INSIDE WALL COVERED BY ADHESIVE PICTURE HOLDER
MICROPHONE OR PINHOLE LENS
BURNED OUT BULB HAS BUG
CEILING
ROOM: Ron's office
DATE: 12 July 1987

What Does a Bug Look Like?

Consider a universal truth about inside devices: They all require (or are) a microphone, sometimes called a transducer. Transducer is a generic term for anything that changes energy from one form to another. A microphone changes acoustic energy (sound) to electrical energy. A speaker generally changes electrical to acoustic, but it can work both ways—a speaker can be a microphone.

Obviously, the microphone has to be placed in such a way that it will pick up people's voices inside the room it is in. A room with drapes or curtains, furniture, plants, and wall hangings has better acoustics and better places to hide a bug. A room with bare walls and sparse furnishings doesn't have as many places to hide a listening device.

Placing any type of microphone behind a solid object will mask some of the sound. Anything less solid, such as upholstery fabric, moss, or leaves on a plant, conceals the bug and lets most of the sound in. Certain types of fabrics and foam plastics that are acoustically transparent (such as are used on stereo speakers) will let all the sound through.

With a few rare exceptions, anything a microphone is hidden in will have a small hole to let the sound in. A speaker can also be used, but it is larger and harder to disguise. The most likely place for a speaker being used as a microphone is inside a hollow door where a hole would be seen easily. Regardless of where it is hidden, the wires have to lead to the listening post, and stringing these wires can take time. They obviously have to go through a wall, floor, or ceiling at some location, and this makes a hidden microphone easier to find.

Metallic paint can be used as wires—ordinary wire will go from the microphone along the edge of the carpet to the wall socket, then the paint is sprayed on the wall to lead to the hole. This obviously is then covered with paint that matches what is already on the wall. Look for discoloration because an exact match is unlikely. Such an installation might work in a cheap hotel room or basement maintenance area, but not someone's living room.

To get the wires out of the room and into the listening post, the listener must use a hole that already exists or make a new one. Existing holes are usually behind the plastic plates that cover plug switches, telephone wires, and TV cable or antennas.

Tiny openings can be made from an upstairs apartment, through the floor directly above your ceiling light fixture. Any bits of paint or plaster will fall into the glass cover and not be noticed—until a burned-out bulb is replaced. Holes drilled elsewhere usually leave traces of plaster, etc. Even when small hand drills are used with a vacuum device, some residue usually remains on the floor.

Likely places for a hidden microphone are behind or under furniture that is close to a wall plug, behind drapes, on top of door or window frames, or wedged between them and the wall.

Now, let's look at finding RF devices. How big is a bug? Bugs can be large and easily seen, or they can be so small that you are not likely to find them visually. On "The Man from U.N.C.L.E.," Napoleon Solo used a transmitter inside a pen to talk to people many miles away. No way. On the other hand, a cellular phone could be built into a shoe like the one Maxwell Smart used.

One device, described elsewhere in this book, was made from an old tube-type, table-model AM radio. At the other extreme, a bug inside a martini olive worked. The AM radio bug transmitted for about one-half mile; the olive worked for only a few yards.

The smallest commercially made FM wireless microphone is usually at least 3/8-inch square and 1-inch long and encased in metal to shield it from the NLJD detector described later.

A homemade bug on a printed circuit board is usually no smaller than one-inch square and can be larger.

Batteries

One of the most important things to remember when making a search is to keep a picture of a battery in your mind as you are looking. All bugs have to have power, and if they are not inside something that plugs into the power line, then they must have a battery. If a bug is to operate for more than a few days, the battery is usually larger than the bug.

A very small FM wireless microphone with a range of a hundred feet or so might operate for two or three days on a calculator battery or a week on one AA-cell, but it doesn't have enough power to send its signal through several walls from an inside office to a building across the street. It may reach the floors above and below and the adjacent rooms.

Higher-powered wireless microphones may reach half a block or so under the right conditions, but to last for more than a few days, they need several penlight or one C- or D-size cell. A really large bug with a range of several miles will drain a C-cell in a few hours. To keep transmitting for days or weeks, it requires something on the order of a motorcycle battery.

A number of small batteries can be used to provide the same amount of power as one larger one. A motorcycle battery obviously will not fit inside a hollow door, but a dozen C-cells chained together in parallel can power a wireless microphone for a year.

A D-cell battery will not fit inside a quarter-inch hole drilled in a wall, but dozens of hearing-aid batteries will. It's been done.

Photocells that generate electricity when exposed to light can be used to power a bug. Two small cells could power a small wireless microphone that normally uses a calculator battery. Half a dozen would power a larger wireless microphone. These cells have a surface area of at least one square inch, which has to be exposed to light. Although solar-powered bugs can be used only in certain areas, they have the advantage of never needing the batteries replaced. Inside a ceiling light fixture, certain types of lamp shades, and in a window frame are likely places for a solar-powered device.

What does a bug look like? Look for any kind of electronic device, a small printed circuit board, or a small plastic or metal box or molded rubber block. The block will have a small hole to let the sound into the microphone, and it usually has an antenna wire. The rubber can be molded into shapes other than a block, as well. A glob of caulking compound or putty could hide a bug. Such material would have to contain a battery (which, if seen, would give it away) that might last a week or so. This device has a very short range.

Anything that looks as if it doesn't belong should probably be suspected and examined, and anything that has wires coming out of it should definitely be suspect. Keep in mind that bugs can be disguised as, or hidden in, almost anything.

A bug can be built on a thin, slightly flexible type of circuit board using very small components, such as surface-mount chips, which are smaller than ordinary integrated circuits.

The battery can be made from a number of small individual cells that are spread out over the board. Such a device can be less than a quarter-inch thick and can fit in the space between the spine and cover of a large book.

Antennas

In an episode of "The Equalizer" on TV, an RF bug about two inches square was placed inside the limousine of the bad guy, and the sound it transmitted was heard clearly several blocks away. A bug of this size could have such a range, but not without the one thing missing from the bug on the show: the antenna.

Even a high-power bug isn't going to transmit very far without an antenna, which can be anything made of metal. A strip of aluminum foil, a curtain rod (an excellent antenna), the brackets that hold a lamp shade, wire that holds a picture on a wall, a metal bar for hanging clothes, springs inside furniture and mattresses, a filing cabinet—literally anything made of any kind of metal—will work, as long as it is not grounded. Keep this in mind when searching for a hidden antenna.

A later chapter contains some examples of places that bugs have been hidden. Keep these in mind also. Start with the windows, which are one of the best places for the bugs described above because the glass doesn't interfere with the signal as walls can. Check curtains and drapes. Stand on a chair or ladder so you can look down at the top of the rods. Use a flashlight. Look in the window frame for a solar cell or infrared transmitter. A bug could be painted over to make it less noticeable.

Check on the outside of the glass for anything stuck to it. Have a look from the outside if possible. A contact microphone could be placed on the glass, with fine wires hidden in the shingles or behind a downspout or even painted over, and lead to a nearby listening post or to a transmitter hidden in the grass or buried with the antenna just below the grass. Look closely for tiny wires or places where the paint is discolored and doesn't match.

Then look up from below. Small bugs can be hidden in the folds of the drapes. Shine a small flashlight from behind the tops of the drapes and look for the silhouette of a listening device. The metal hooks that hold the drapes to the rods could be used as an antenna.

Look behind the brackets that hold the rods to the wall. Open or close the curtains if necessary. Tiny relay bugs can be hidden inside the plastic handles on the drawstrings of drapes and venetian blinds.

Lamps are another likely place for bugs. Some shades are made from two layers of material, one inside the other. A small bug could be dropped inside from a small hole in the top. Turn the lamp on and look closely for shadows near the bottom.

A small, or not so small, bug can be hidden behind a picture on a wall. Use a flashlight and look very closely. If it is hung with wires, look for another wire attached to them. Use a mirror and look along the edges.

Plants can easily conceal snooping devices. Look carefully.

Check underneath desks, chairs, and other furniture. Crawl under them and use the flashlight. Look for signs of fabric having been cut and sewed up or tacks pulled loose and replaced. Look closely at the buttons on the upholstery to see if there seems to be a difference in color, if one looks newer than the others. Large upholstery buttons are one of the best places for hiding small bugs. The fabric lets the sound through, and with an upholsterer's front button hook, the bugs can be switched in a few seconds.

Of course, this requires that the spy know the kind of fabric used and be able to obtain the same kind. Because of their small size, they have a short life, but if they have to transmit only a few yards, they might last a week. This is a long shot, but it has been done. If someone wants information badly enough, they will do whatever is necessary to get it.

Get a ladder and replace a bulb in the ceiling light fixture. Have a good look here; this is another favorite hiding place. Look for scraps of paint or plaster from someone having drilled a hole from above. Make a note of any such opening.

Bugs have been built into burned-out light bulbs. There is enough space for a large bug inside one, and it has a constant power supply. In a fixture with a number of bulbs, a single burned-out one might not be replaced for months. It's one of those little things that people never seem to get around to.

If you have a ceiling light fixture, then the apartment below you probably does also. Check the carpeting in the center of the room for anything irregular, a bulge or soft spot, or a sound hole. Use a magnifying glass and flashlight.

If you have a smoke detector, replace the battery and have a close look. With the electronic components that belong there, it may be hard to tell if there is a bug inside. Look for a microphone. If in doubt, compare it with another of the same model or replace it.

Look closely at your books, using the flashlight, for any signs that the material on the spine has been tampered with, such as a tiny hole to let sound into a hearing-aid microphone.

Quietly remove a few of the larger ones and look behind the others with a mirror and flashlight. Look along the tops for signs that dust has been disturbed.

Check the carpet all the way around the edges to see if it can be peeled back; a small bug can be hidden there, as can wires for a microphone.

Disguising the Sound of a Search

Anything that makes noise will help to cover the sound of a search, but some noises are better than others. A vacuum cleaner is one good cover. Much can be done while the carpets are being steam-cleaned. An electric drill makes a good cover. Find something to make some holes in, put up some new book shelves, do some remodeling, have a loud party.

Repainting, having the walls cleaned or repapered, or rearranging furniture all help to conceal the sounds made in searching.

Different sounds can be used for different parts of the search. For example, removing a wall plug cover requires the loudest sounds you can generate because you are making mechanical noise very close to the microphone. After arranging suitable noise, as quietly as possible, remove the covers from wall plugs, switches, and cable TV. Keep in mind all the things that can be in such a location: a microphone or the plastic tube from a microphone, a pinhole lens from a TV camera, an RF bug, a wireless microphone, or a light modulator. A wall plug cover is a universal place for surveillance devices. In a plug or switchbox, there should be nothing else but the plug (outlet) or switch.

The plug will have either one or two heavy wires (number 12 or 14 and usually white and black) on each side of the plug and sometimes a bare copper wire that connects to a screw on the metal box. This is a ground wire.

A switch will have two, possibly three (on a three-way switch) wires and the bare ground wire. Look closely. Use the flashlight and mirror. No small wires or anything else should be there.

If the TV cable comes in through a hole drilled in floor or wall, you can't see much, but if it enters from a box, look inside. There should be nothing inside it except the cable—no electronic components, other wires, or splices.

Now check the place where the phone wires come in, usually in one of two ways. Either a small four-wire cable will enter through a small drilled hole, or there will be a switchbox with a plastic cover like the plugs and switches, and a modular jack in the cover.

If there is a plate, remove it and look inside. There may be a small beige-colored cable with four wires inside, which have red, green, black, and yellow insulation. Or there may be two single wires of other colors. If so, look for a large cable inside the wall. Use a mirror and flashlight to see if you can find it. It may be inside the wall and hard to see. Make a mental note of the type of cable.

Every book you have should be removed from the shelves and opened to see if it has been replaced by a hollowed-out one. Remember that large books can have a bug inside the spine if it is loose, like many old law books, some of which are seldom used. Then use a flashlight and check the empty shelves carefully.

Quietly remove pictures, bulletin boards, and other wall hangings and have a close look. Bugs can be built into the frames.

There are bugs that are long and thin and will fit inside the wall through a small hole.

The hole can be hidden by an old, unused adhesive picture hanger that has a tiny hole for the microphone. The batteries, small hearing-aid types that are chained, can supply a low power bug for weeks or months.

Hollow doors have enough space for a large bug and a long antenna. A number of small batteries chained together, as in the above example, will fit inside, and a speaker, used as a microphone, can be wedged inside with foam rubber to hold it in place. The surface of the door, which vibrates with sound, acts as a sounding board for the speaker. No sound hole is needed.

Look at the top of the doors for evidence of tampering—e.g., a hole that has been covered over, patched, or even left open. If you found a bug inside a door, you would not be the first person to do so.

Upholstered furniture should be closely examined for tears in the fabric, tacks that are loose, or labels or stickers that could conceal an opening into which a bug could be inserted. There is a lot of space inside furniture to accommodate a large bug and many batteries, and the springs make a good antenna. If in doubt, have it reupholstered or replace it.

Typewriters and printers can also hide bugs. To wire them to the power line takes time, but a small battery-operated bug can be hidden inside the case from the top. You know what to look for.

Phones can be unplugged and examined, but since there are phone bugs that are as small as a pea, they might be missed. Have them examined by an expert or just replace them.

Now consider the possibility of a Trojan horse. Any kind of gift could contain a bugging device. A desk pen-and-pencil holder, decoration or sculpture, wall hanging, or a plant.

A gift that plugs into the wall outlet should be removed from the area, taken apart, and checked physically and electronically, using equipment described in the next section. Table lamps are one of the best places to hide a listening device. A typical ceramic base lamp could hide a multitude of devices.

Anything that is "accidentally" left behind by a visitor, client, friend, etc., should be removed from the area and checked out or placed inside sound-absorbing material and put in a storage area or closet.

Briefcases can have bugs built into them that you can't see without tearing them apart. They can also conceal small tape recorders with voice-actuated remote control (VOX) switches and can be easily modified to record for eight to twelve hours.

The man had a legitimate claim. There were witnesses who saw him pushing the wheelbarrow up the hill when it fell on him. The insurer tried to deny the claim and refused to pay him disability, even though several doctors said he was injured. He *threatened to sue and showed them that he knew enough about civil law to do so.*

The insurance representatives called him in for a meeting, after which he "forgot" his attache case, which contained a VOX tape recorder. When he retrieved it and listened to the tape, he learned that the insurance company was willing to "buy him off" rather than fight him in court.

A week later he left their office with a check for $5,000 in his pocket. They tried to cheat him out of what he was legally entitled to, and he fought back.

TYPES OF EQUIPMENT USED FOR ELECTRONIC SEARCHES

In this section, we will examine countersurveillance devices that are used for finding bugs and how they are used. Some are inexpensive and easy to use, while others cost thousands of dollars and require an experienced operator.

The Bug Detector

A bug detector is a small battery-operated wide-band radio receiver that will detect RF bugs over a wide range of frequencies, typically from 1 to 1,000 mc. They vary from shirt-pocket-size to about 4 by 6 inches.

Most of these units are not tunable. They receive the whole range without needing to be tuned. Outside stations can be eliminated by reducing the sensitivity, or the search can be done in the early morning when there are fewer commercial stations on the air.

Some of the better models have a verify mode. When the LEDs indicate a signal, the mode is changed to verify, and the signal it has detected comes through the speaker or headphones. This tells you what you have found and eliminates false signals.

These detectors run from about one hundred to several thousand dollars. Capri Electronics makes the model TD-53 with the verify mode, and it has optional probes for detecting infrared light, carrier-current (wireless intercoms), and video cameras.

I tested the TD-53. A very low-output wireless microphone was hidden inside a retail store while I was outside. I found it in less than a minute.

To use a bug detector, walk through the area several times holding the antenna probe at different angles and poking it into corners and close to furniture and other appointments. When it picks up a signal the red LED indicator on the front panel lights up and changes as you get closer to the transmitter.

Then you can switch to the verify mode. If the speaker is being used, you'll hear the squealing of feedback. If using the headphones, you will hear the sounds you are making as you move around. Using headphones prevents the listener from knowing that the device has been located—there is no feedback for them to hear.

A good bug detector used carefully will find any RF transmitter in the search area with the exception of high microwave devices (which are rare) the burst transmitter (even rarer), and possibly the low-frequency-type mentioned in a Part I. Some bug detectors cover low frequency; some do not.

Microwave Detectors

A microwave detector is the same as the bug detector, but it works on (receives) microwave frequencies, and some models have special filters to block signals on nonmicrowave frequencies that could interfere. The coverage of most of these is about 800 mc. to about 2 or 3 gc., and they will not detect the 10 to 11 gc. types or some video cameras that operate on about 4 gc.

Ultrasonic Sound Generators

All RF bugs (wireless microphones, converted cordless phones, etc.), IR transmitters, and tape recorders require microphones to pick up sounds. Most can be found or jammed by using ultrasonic sound.

The USS device generates two separate signals that sweep through the range at different speeds so they produce all combinations of the two frequencies.

When these USS waves strike a microphone, they cause it to oscillate (vibrate), which jams it and makes it deaf, and some types emit a whistling sound, which gives away the location.

This works on most but not all microphones. For it to work, the microphones must have a frequency response that goes beyond audio and into the USS area. Carbon microphones, for example, and the microphones in some tape recorders do not respond to the USS generator.

A jamming system called "The Exterminator" is available from CSI.

Tape Recorder Detectors

All but a few cheap tape recorders generate an ultrasonic sound called a bias, usually at about 100,000 cycles. A device that finds a hidden tape recorder by detecting this sound is available from Sherwood Communications and CSI. If a recorder were to be left in an attache case, as in the previous example, this would most likely find it.

Scanners

Scanners are useful in countersurveillance work. They don't work as fast as bug detectors, but they have the advantage of providing you with the frequency that a found bug transmits on. This is useful in making a profile. Also, some scanners cover frequencies that many bug detectors do not.

The AR-3000 is recommended, as it will pick up everything from DC to infrared. Actually the coverage is 100 kc. to 2,036 mc.—which is continuous, meaning that nothing is locked out. Because of its wide coverage, it will detect any RF device except the burst and some microwave transmitters.

Most scanners have two modes: scan and search. Using the search mode, the operator can set a high and low frequency limit, and the unit then scans through this area over and over, looking for a signal. Unfortunately, when it finds a station, it stops and stays there until it is reset or the station stops transmitting.

The AR-3000 has the search lock-out feature that no other current scanner has. You can set it to search through a certain part of its coverage and lock out the unwanted signals. Up to forty-eight separate signals can be deleted, so the scanner can search for bugs without the operator having to reset it constantly.

For example, if you wanted to search from 160 to 165 mc., an area used by the federal government for bugs and body microphones (wires), the scanner would stop on the NOAA National Weather Service stations on 162.45, 162.55, etc. The lock-out feature causes the unit to pass over these stations and continue looking for bugs.

Here are two ways to use a scanner. For the first, you need a phone that has an infinity transmitter (usually called "answer back") built in, such as the Panasonic KX-T2432 mentioned above. Set the scanner to cover a particular area you want to search and lock out the unwanted signals. Turn on a radio in the room you are searching, plug a speaker with a long cord into the scanner's external speaker jack, and lead this into another room. Place the speaker next to the phone.

If the scanner finds a bug, it will stop on its frequency and hear the music from the radio, which comes out the speaker beside the phone. All you need to do is call the phone and activate the answer-back feature to see if you hear the music.

The second method can be used if you don't have an AR-3000, or if there are too many interfering stations, such as those for pagers, which are everywhere in a downtown area. It isn't unattended, but you can use it while doing something else.

Set the scanner beside you where you can easily reach the panel buttons. Plug headphones into the phone jack, hang them around your neck, and sit back and watch videos.

When the scanner hears a bug, you will hear your TV sound coming from the headphones. To search a different room, just use an external antenna placed in that room, turn on a radio, and go back to watching television.

To be thorough, search the entire range, but there are a number of smaller areas to start with. The best place to start is the FM broadcasting band, where most wireless microphones transmit. FM is from 88 to 108 mc., but some wireless microphones can be adjusted to work slightly above or below FM, so search from 80 to 115 or so.

One of the most difficult bugs to find is set to transmit near the sound portion of a TV channel. Because of the close proximity, these are often covered by the buzzing that TV sound signals generate and can be quite hard to find.

The use of such device is called "snuggling," and it signifies the work of an experienced spy. The frequencies for VHF TV channels are listed in Appendix D, along with a list of common frequencies used by wireless microphones and other such devices.

The military aircraft and operations band, from 235 to 420 mc., is a good place to look. Until a few years ago, scanners (or any receivers) that tuned this area were uncommon. The military surplus URR-35 and R278 covered most of this band, but were hard to find. This made for a safe area in which to place RF bugs, and they are still being used there.

If nothing is found in these areas, then do the continuous search with whatever scanner you have available, but if the coverage is less than the AR-1000, you will be missing some areas in which bugs can work.

The Hunter

The scanner methods discussed above are effective, but here is something that does it one better, the Hunter. Made by CSI in Santa Clara, California, it is a modified ICOM R-7000 communications receiver with a specially made controller that sits on top.

To search for an RF bug, you place a second unit called a scout in the room(s) to be searched. The scout emits a 4,000-cycle tone that will be picked up by any bug in the room.

Meanwhile, the R-7000 (an excellent receiver) is searching from 25 to 2,000 mc., listening for the tone emitted by the scout. The controller causes the R-7000 to skip any signal that does not contain that tone, and because of extensive modifications, it hears AM, FM, and single sideband (SSB) without requiring you to manually switch modes and redo the search in each one.

The Hunter searches continuously until it finds the tone, which means it has found a bug. It then stops and stores that frequency. You can set it up in your office and go home, leaving the Hunter to do the searching for you. It's great for remote-control bugs. It also can trigger an audible alarm, so you can call using a phone, as in our example above, to see if it has found anything.

The Scan-Lock

The scan-lock is a special scanning receiver that can be computer programmed to overlook all of the known transmitters in the area in which it is being used. In other words, it will lock out commercial radio and TV stations, amateur radio and business band systems, etc. Once programmed, it will look for bugs continuously until it is reset.

Scan-lock was supposedly developed by British intelligence and has a wide coverage, 100 kc. to 2 gc., which it can scan through in about six minutes. Once classified technology, the scan-lock is now available commercially, but it is hard to find. Try Sherwood. It has one now and then.

The Spectrum Analyzer

The spectrum analyzer is a useful device available for detecting RF bugs, but it also is one of the most expensive. It is a sophisticated receiver with a wide coverage that displays what it receives on a computer screen. Depending on the model, the screen can display an area, called a window, several megacycles wide.

These signals are displayed as vertical blips, which by their size and shape indicate information about the signal: mode (FM, AM), frequency, and other useful data. To use it, the operator sets the analyzer to display a portion of the radio spectrum to be searched and watches the screen for signals.

The AX-700 analyzer, available from EEB, covers 50 to 900 mc., has 100 memory channels, and sells for around $800. It also has optional coverage of 100 kc. to 50 mc. for a modest $249, and it can be interfaced to a computer via the built-in RS-232 port. Sensitivity is comparable to better communications receivers, in other words, quite good.

The Hewlett-Packard (HP) model 71210C receives and displays almost the entire radio spectrum, from 100 cycles to 22 gc. with optional coverage to 325 gc. This coverage will find any surveillance transmitter. It has a color multiplexed screen and all the bells and whistles one could want. Base price is about $80,000. You probably get a discount if you buy two.

Tektronix also makes spectrum analyzers, and like the HP, its top-of-the-line models are of excellent quality and comparable price. Both companies also have less expensive models.

Most two-way-radio repair shops have spectrum analyzers, and if you know someone in that business, you might be able to borrow one to sweep for RF listening devices. But read the manual first; they are a bit more complicated than scanners.

The spectrum analyzer will detect a burst transmitter, but this takes time, depending on the model. Some have a wider window than others, and some can be programmed to search different areas of the spectrum.

A continuous sound causes the memory chips in the burst device to fill, which then prompts it to transmit. When it does, the spectrum analyzer receives the transmission, and the display reveals the frequency. Some models have a storage memory that freezes the image on the screen.

Using surface-mount technology, a burst transmitter that could store about ten to twenty minutes of sound would be about the size of two 35mm film boxes. The exact size would depend upon the skill of the person who builds it and the parts available.

The Nonlinear Junction Detector

Bugs are made (in part) from transistors and diodes, which are made from layers of different types of silicon (P-type and N-type), and the point at which these layers meet is called a junction. One of the characteristics of these junctions is that when they are subjected to microwaves of a certain frequency, they reflect back microwaves of different frequencies, called harmonics.

A nonlinear junction detector (NLJD) floods the area to be searched with microwaves, and if a bug is present, it detects these harmonics from the transistors and alerts the operator by registering on a panel meter or sounding an alarm. The NLJD looks somewhat like a metal detector. The main part can be clipped to a belt or shoulder sling, and the probe is swept over the walls, etc.

During construction of the U.S. Embassy in Moscow, the Soviets buried hundreds of cheap diodes in the walls. Then when the countersurveillance crews tried to use their NLJDs, they were so swamped with false readings that they couldn't find the real bugs. Clever, those Russians.

One of the features of the NLJD is that it can detect a bug that is not turned on (remote-control activated) or has a dead battery, as well as a wireless intercom and anything that has transistors.

Unfortunately, a bug that is well-shielded (in a metal case) will be missed by the NLJD, and the device also tends to detect other types of junctions. More than once a wall has been ripped out to find a bug only to discover a corroded plumbing solder joint. Though not perfect, the NLJD works in the hands of an experienced operator, but it is not for amateurs.

A NLJD sells for about $15,000, and I have heard that an improved type is being developed.

The Frequency Counter

Another device for finding bugs is the frequency counter or meter. Portable pocket-size counters, available from Optoelectronics, range from about $119 to $375 and cover from 10 cycles to 2.4 gc.

When the antenna is in the presence of an RF field (radio waves), it detects it, counts the number of cycles per second that it is receiving, and displays the frequency on the front panel. The frequency counter is as sensitive as some scanners, very effective, much faster, and has the added advantage of indicating the operating frequency of the detected device. This may tell you something about the person who placed it, useful in building a profile, which is detailed later.

To use, turn the unit on and walk around the area being searched, as if you were using a bug detector, and watch the panel display to see if it stabilizes, i.e., displays a number that doesn't keep changing. Then program a scanner to the same reading to verify it and see what you hear. Use an earphone or the squealing feedback sound will tell the listener you have found and now own his bug.

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As you have seen, the cost of countersurveillance equipment is considerable. A first-rate spectrum analyzer, NLJD, and a few other sophisticated gadgets can add up to $100,000. This equipment is fascinating and fun to use (if a little pricey for most people), but the vast majority of the RF bugs used by anyone, even the pros and the government, can be found with the moderately priced frequency counter from Optoelectronics or the TD-53 bug detector and a shortwave receiver.

SEARCHING THE PHONE LINES

As mentioned in a previous section, a phone-listening device can be direct (a wire connected to the line leading to the listening post) or remote (a RF transmitter connected to the line, which radiates the signal to the listener without wires).

In either case a wire will be connected to your line. If it is, then you can almost always find it. The few exceptions will be explained later.

You will need the tools used in the physical search, an ohmmeter and something to connect across phone lines to listen in. It will be necessary to get to the place at which the phone lines all come together, the 66 block or other connection panel, possibly several times. Allow an hour or two for the search.

In the physical search, you made a note of the type of cable used. If it is the four-wire type that goes to a modular jack, remove it and look at the back for anything that does not belong there. There are line-powered bugs as small as a pea that can be hidden there. They have two thin wires connected across the screws that have the red and green wires connected to them.

If there is a large twenty-five-pair (or larger) cable, is it close enough that you could splice a wire to it? If so, then someone else could do so.

Tracing Wires

In larger office and department buildings, either type of cable will probably go straight down, inside the wall, to the basement, so there may not be any way to get to it. Other buildings may have the wire running through the walls over doorways, along halls, etc. Follow it as far as you can.

Any wires branching off the line should be connected inside a standard four-wire telco block or modular jack, or held together with small plastic connecting devices such as wire nuts or scotch-locks.

A splice, wires twisted together and left bare or covered with tape, will have been made by someone other than a telco installer—such as a wiretapper. If you find a splice, follow it as far as possible to see where it goes, but leave it alone for now.

A small line-powered bug may be wrapped inside a piece of tape or hidden behind a connection block or inside a short piece of plastic phone cable insulation that looks like a wire that was connected, then cut off. Remember that anything that small will have a range of a hundred feet at best.

Remove any tape and connection blocks you find and look inside and behind them. Just as above, the only thing that should be there is plastic: four screws and the two or four wires inside the cable with red, green, yellow, and black insulation.

Also look for a coil of wire that will be an inductive tap or "pick-up." It can be of any size, as small as a thimble, or a flat plastic plate several inches across. Whatever its size, it will have a wire coming out of it that leads elsewhere or is attached to an RF bug. Look for a battery.

Inductive pick-ups are usually placed close to a phone where there is more magnetism to pick up. The flat plate type is placed under the phone, and smaller ones have a suction cup to hold them on the receiver. They are seldom used along a phone line because they don't work very well and easily pick up interference from power lines and many kinds of appliances, motors, etc., but they do exist.

In your search, you might find a small circuit board about one inch square with electronic parts and a small plastic block about a quarter-inch square that has four small slide switches This is the dual inline package (DIP) switch. It will have four wires, two red and two green. This is a radio frequency interference (RFI) filter used when transmissions from commercial radio stations get into the line. It is not a listening device.

When you reach the place at which the line disappears into a wall or floor, pick up the search from the other end.

If you're searching an apartment on the ground floor and the connection block is in the basement, you can push a stiff wire, such as a coat hanger, into the hole, which you may be able to see from inside the basement. Another trick is to shine a very bright light into the hole. This makes it easier to find the wire again.

Some buildings often have the connection panel on a basement wall where anyone can get to it. If so, look for apartment numbers beside the pairs of terminals. If there are none, follow the wires and look for tags hanging on them with the numbers. Also look for a ceramic or metal block about four by six inches, a single-pair station protector (SPSP), which may have the apartment number written on it. Check it out and follow the wires as far as possible.

Newer buildings usually have a distribution closet in the basement and sometimes a smaller one on each floor called a floor closet. These usually (but not always) are in areas that are hard to get to and sometimes are locked. If so, perhaps a maintenance person will let you in, or you might find a way to get past the lock.

The connection panel(s) may be locked with a TORX security screw, which is round and has a hex-shaped opening in the top. These can be opened with a special tool called a TORX wrench, available from Bit Connection.

When you have accessed the block, look again at the rows of connections to see if they are labeled with the apartment numbers, or there may be a written list inside the block cabinet or elsewhere in the closet. Make a note of the colors of the wires in the block. The twenty-five-pair cable has ten different colored wires inside it, and if this is the type of cable inside the wall box in your unit, then the wires coming into the block should have the same number of colors, not just red and green.

These colors are in two groups of five: blue, orange, green, brown, and slate; and white, red, black, yellow, and violet. Each line will have one color from each group. This makes twenty-five combinations.

If a larger cable is used, fifty or one hundred pairs, the wires will be divided into binder groups each with twenty-five pairs, using the same color codes and separated by wrapping them in a color-coded string or ribbon.

If, however, they are multicolored and the cable in your unit is the small four-wire type, then one of two things is true. First, there is a large cable back inside the wall where you couldn't see it. If the four-wire cable enters through a drilled hole rather than a box with a plastic cover, you won't be able to see the large cable without making a hole in the wall.

The other possibility is that there is a floor closet, a small distribution closet on some or all floors of the building. The small wires will go from it to each unit, and a large cable will connect the floor closet to the main panel in the basement.

A floor closet is a likely place for a tape recorder or remote phone bug.

If the lines are not labeled, then you have to trace your line.

The easiest way to do this is to just leave the phone off the hook and, when the beeping sound stops, turn on a radio near the phone. This gives you a sound to listen for.

Next, you need something to use to listen to all of the lines that come into the block. A lineman's test set is ideal, as it has a listen-only switch. If you are using an ordinary phone, connect alligator clips (available at any ham radio or electronics store for about a dollar) through a small capacitor to the red and green wires of the phone. The reason for this is to reduce the click sound—if you connect across a line that someone is using, he or she will probably not hear it. There is no reason to cause that person to think someone has tapped his/her line.

If you are using a phone that has a modular plug, buy an extra cord that has the plug on one end and small metal "spade" clips on the other. The clips connect to the screw terminals on the alligator clips.

Now go back to the main closet block and start checking the pairs by connecting the two alligator clips to each of them. It does not matter which clip goes to which terminal. Some blocks (usually older ones) have pairs of large brass screws in two or more vertical rows. Other blocks have rows of small curved clips to which the wires go. These are called insulation displacement connectors. A small device called an impact tool is used to push the wire into the clip, make the connection, and cut off the loose end of the wire.

Try them until you hear your radio playing and note any numbers beside the terminals or count how far the line is from the top pair. Look closely at your pair of wires and the terminals to which it goes. There should be only two pairs of wires: one coming in from the outside and the one going to your phone.

On an older block, in an old building, the incoming wires are usually of a different size and color—larger with black insulation. In the newer blocks that use the clips, each of the two clips have one wire for the line to the phone, and the incoming line usually enters the block from the back. If there are more than two pairs of wires connected to any of the terminals then the third is probably a tap. See where it goes.

The black and yellow wires in the two-pair cable are never used. If there is a second line, it will have its own separate four-wire cable. If you see black and yellow wires attached to yours, it will be a bridging tap.

Look behind the block, if possible, for the same things as before—a splice, tape, coil of wire, etc. Also check that the block is securely bolted to the wall and that there is no evidence that it has been removed and replaced, such as plaster dust or paint chips on the floor. Also look for places on the wall at the edge of the block that have been repainted so the colors don't match. Remember the earlier example of using metallic paint as wires? Look for this as well.

In both new and old buildings, there might be a small box on the wall near the telco block, which may have the telco name on it. It is big enough to hide a small tape recorder, which can have extra batteries, be modified to record for ten hours or so, and be operated by a dropout relay. If you see such a box, open it and see what is inside. If it and the telco block are mounted on a wall made of wood or plasterboard, find out what is on the other side. It can have a jumper wire attached to the back of the telco block from behind the wall, which you otherwise would not have found, as you might not have paid any attention to the other box.

The next step is to measure the resistance of the line. Meters that will do this are available from any electronics supply house. An analog meter costs about $35. A decent digital meter is available from Jameco for $40. The instruction book that comes with it contains all the information you need to use it.

There are also products that will do this without your needing to learn how to use the ohmmeter, such as the Tap Trap for about $100, but they use LEDs instead of meters. The meter is more accurate.

First a short primer on Ohm's law, which is the most basic law in electronics. An analogy that compares a phone system to a water tank on a tower is useful. Gravity makes water flow to a lower level; the electronic "gravity" that makes electricity flow is voltage or electrical pressure. The flowing of the water or electricity is current, and a valve that controls how much water or current flows is resistance. High resistance is like a closed valve, no water or current flows; whereas an open valve (no resistance) allows as much water or current to flow as the pipe or wire can handle.

Measuring Line Resistance

Telephones work by being connected with wires through which a small electric current flows. Wires have resistance to this flow of current; the longer the wires, the greater the resistance. (Technically, it is impedance, which is a combination of resistance and capacitive and inductive reactance).

Any device electrically attached to a line between the point at which the line enters the house (SPSP) or building (block) and the phone inside will make a change in the resistance of the line and, unlike downline taps, can be easily found with an ohmmeter.

Before you leave the 66 block, disconnect both the incoming line and the line going up to your phone. When you get back, unplug your phone and anything else that is on the line—answering machine, computer modem, etc.

Set your meter to one of the higher scales (R x 10K ohms or R x 100K ohms), then short the leads together, and watch the needle to make sure it reads zero. (This is not necessary with a digital meter.) There is a small knob marked "ohms adjust" to set it to zero if necessary.

Connect the test leads from the meter to the red and green wires in the phone block or modular jack. The other end of the wires is not (or should not be) connected to anything, so there is infinite resistance. On the analog meter, the needle should not move.

If the needle first went toward the zero end and then slowly started back the other way, something is on the line; this is a capacitor charging. If it moves, make a note of the reading.

Different brands of digital meters have different displays. Read the instructions to see what a very high or infinity measurement should read.

The next step is to short the red and green wires by twisting the bare ends together or connecting another short wire across them. Take your meter and go back to the closet. Set the meter on the lowest range, usually R x 1 or R x 10 ohms, and measure the same wires, still connected to the block terminals.

What you are now measuring, of course, is the resistance of the loop of wire. One thousand feet of number 22 wire has a resistance of 16 ohms, so if your phone is 500 feet from the block, or on about the thirtieth floor, that's about what the meter should read. If it is more than 16 ohms, there is likely a series tap on the line. Check the meter, make sure the ohms adjustment is set right, and try it again.

There is one more check to make. With both pairs disconnected, measure across the terminals on the block, from the line in to the line out terminals on one side and then the other. They should read a dead short. If not, then a series device is hidden inside or behind the block.

If you got a high reading in the first test, measure across the terminals the other way. The reading should be infinity. If it is less, a parallel device is inside or behind the block.

If the readings aren't normal, then either you missed something while searching the line, or whatever is connected to the line is in a place you couldn't get to. If there is a floor closet, check it out the same as the main one.

Sometimes the lines will go down an elevator shaft or through a maintenance area. See what you can find out from the maintenance people or find out who did the inside wiring. Most of it is done by private contractors since the Bell system break-up. There may be labels on the block with the company name on them.

The other possibility is that someone got into the cable from one of the units and placed the tap, and unless you can get into every apartment that the cable serves, you aren't going to find it. There is, however, a way to destroy it described later.

Once the phone wires leave the 66 block, they become the telco's property and responsibility. This is the "point of demarcation." Usually, there will be another block that contains fuses or overload protectors. If you can get to it, check it out the same as the 66 block.

The Reflectometer

At this point, you have done everything you can do. Put everything back the way it was. Now you have two more choices.

The first is to call in an expert who will use a device called the "time domain reflectometer" (TDR). The TDR is a sophisticated and very expensive electronic device that will send a signal down a pair of wires in such a way that a break in the cable or another wire that is connected to it will reflect part of the signal back to the unit. The qualities of the reflected signal are such that the TDR can measure the distance from the unit to the break or tap and display it on the screen. Hewlett Packard has a TDR for only $13,000. HP doesn't make anything cheap, but it makes some of the best electronic equipment on the market. There are other brands on the market in the $2,000 range.

Gremlins, Martians, and Ghosts

The other option is to have the phone company do the search. This can be an interesting experience. The security division of the telco that deals with wiretapping does not like to talk to the public. If you call the telco and try to get through to security, they will tell you this. You must persist until you succeed.

Then you will be screened. They are used to people whose phones have gremlins in them, whose departed husbands or wives are trying to contact them but the operator won't put the call through, and whom the Martians call late at night. You will immediately be classed as such a person until you can convince them you are a rational human being who does not use LSD very often.

Now the obvious reason you are calling them is because you believe there is a tap on your line. Telco personnel do not like that word. They get real serious about it. I called Pacific Bell—many times—to see how its personnel handled such requests. I carefully explained that I was writing a book; I made a point of telling them this (again, many times), and finally someone said he would have a representative call me back.

Several days later a gruff-sounding gent using a speaker phone called and said, "So you think someone has tapped your line, eh?" with an undisguised mixture of sarcasm and condescension.

I explained that I was writing a book and I was reasonably rational, but he was very uncooperative and refused to tell me anything about how the telco would go about such a search, but after repeatedly asking the same question, he finally admitted that, yes, Pacific Bell would make such a search, and, yes, it would arrange to have my line physically disconnected at its end to make resistance measurements. I asked if he would tell me how the line is routed from any given phone to the central office, to make it easier to estimate the line resistance, but he didn't want to talk about it. When he hung up, he did not say anything like, "Thank you for calling Pacific Bell." Like I said, talking to the telco is an interesting experience.

So if you decide to have the telco test your line for taps, you can get it done but expect a little reluctance. Some professional debuggers are well known to the telco, and they can cut through the red tape.

DOWN LINE

Once the wires leave the overload protection system, they go into a heavy plastic tube that is filled with a jellylike substance to keep moisture out, which leads to the underground conduits or to a telephone pole in an alley.

Earlier, I said down-line taps are difficult to find, especially inductive taps. In the above test, the resistance of the wires from your phone to the block was a known quantity—you knew what the meter should read. With a down-line tap, there is no known quantity.

Even if it were measured when the phone was first installed, the resistance can change from new cables being installed, lines being rerouted from one switching office (SO) to another, or other factors. Even variations in temperature change the resistance of wire.

An inductive tap is not physically connected to the line and does not change the resistance. It could have an insignificant effect on the impedance of the line, but a change in temperature of a few degrees would have as great an effect. One "expert" from a large company that sells countersurveillance equipment told me that he has a machine that will "find any phone tap no matter what kind or where it is." No way. The real experts will tell you about line resistance and take measurements for later comparison, or use the TDR.

I also said earlier that down-line taps are rare. The first place to access the line after it leaves the building is on a telephone pole or junction point. A wiretapper who wants to climb a pole to tap a line has two ways to do it. First, he can use an extension ladder, but this will attract attention, especially without a telco truck on the scene. The other way is to use climbers and a safety belt. These cost about $300, and the climbers are not easy to use. It takes some practice. Take my word for it. A lineman's test set will add about a hundred or more to the cost. This eliminates most amateurs.

Next, the climber has to open the metal pole box that the drop lines feed into, and then he must find which line to tap. This takes time, and people are likely to notice. Spies don't like to be noticed.

If the line to be tapped comes from a single-family home, the climber can see where it enters the pole box, but if there is more than one drop wire coming to the pole, such as from an apartment building, finding the right one can be difficult. Usually, all of them go up the outside wall in a group, and there is no way to tell one from the other.

If the wiretapper knows the number of the line to be tapped and has the telco automatic number identification (ANI), he can use that. When he calls ANI, a computer voice tells him the number he is calling from. If he does not have the ANI number and cannot tell which drop wire is the right one, then there isn't much else he can do.

Once the right line is located, the tapper has two choices: string a wire to someplace where he can set up his listening post, which is not so easy, or install a remote-listen device, an RF transmitter. The obvious choice is the RF bug, taking into consideration size range and battery life.

Sooner or later, the bug will be discovered by the telco maintenance people. Taps have been placed on poles, but not too often.

The telephone company and the police decided that they would decline to prosecute him because of his age, and because they didn't want people to know how easily he had tapped most of the phones on our block. They obviously didn't want anyone to know that a twelve-year-old was an experienced wiretapper.'

The above quote came from a true story about tapping telephones in the early fifties.

In a building where the phone lines leave the block through a tube and go directly to the underground conduit, placing a tap is even more difficult. Once underground, the lines soon become part of a larger cable that is often inside a plastic tube that has pressurized nitrogen inside to prevent moisture from affecting the wires.

There are two places the line can be accessed. The first is called a junction point, which is an underground room accessible only from a manhole. Anyone who pulls the cover off in the middle of an intersection (where they usually are located) is likely to be noticed. If the tapper does get in, then he has to find one line out of hundreds, which requires inside telco information.

The other place to access the line is in one of the large metal cabinets located on street corners. These are called bridging or "B" boxes. Even if he does manage to get to the target line, either through a junction point or "B" box, then what is he going to do? A direct-listen method is fine if he wants to set up a listening post there in the underground room, but it could be difficult to string a wire to a remote listening post from the "B" box on a street corner or out of a manhole cover (cars running over the wire and the like). A remote method, an RF transmitter, won't reach very far from inside the metal "B" box or the underground room.

Most down-line taps use one of two methods. First, a long-play recorder with a drop-out relay is hidden in the junction point by someone who can find a place to hide it and access it to switch the tapes and replace the batteries. This is unlikely.

The other option is a bridging tap: connecting the line to be tapped to a second unused line. But there are three requirements for this option to work: there has to be such a second line, that line has to be in a location such that it will be in the same junction point or "B" box as the target line, and then the wiretapper has to find both of them.

Again, this method requires inside information. There are thousands of pairs of wires in these junction points. The wiretapper has to know the specific pair (by its color code) inside a particular binder group to tap. Without inside information, there just is no way.

Down-line taps are very rare, as I said earlier, and are always the work of a pro or telco employee. For example, this is my conception of how the feds would install a court-ordered phone tap. First, they get the court order; then they would contact telco security. Security assigns a special telco employee to the project, and this person determines the location of the target line and selects a junction point to be used. Then they find an unused pair of lines in a cable that goes into the same junction point. This pair is assigned unofficially to the agency making the tap.

(It is also possible that some federal agencies have leased a number of lines for this purpose. If so, they probably have one or more in a number of junctions—if not all.)

The telco employee and the fed go into the junction point and make the bridging tap from the target line to the unused line. The reason for the junction point bridging tap is that if it were done in the telco central office too many people would know about it. A special circuit is used that balances the impedance of the target line so it won't be detected by tap-finding devices.

I also suspect that since the connection is made in the bridging box it wouldn't show up on a TDR. If this is not so, then the telco could arrange for the bridging tap to be placed far enough away from the victim's home or office to prevent the TDR from working. Depending on the type of TDR, one might work from less than few thousand feet (for inexpensive models) to more than two miles (for Tektronix and Hewlett Packard). If the feds believe the quarry is someone who might use a TDR, they will arrange for the tap to beyond its range.

At the feds' offices, probably in a special room for this purpose, the incoming line from the bridging tap would branch off to three open-reel tape recorders. Three are used because the tape might be used as evidence in court, so originals (not copies) have to be made available to the court and the defense attorney.

A question I've been asked: Is it possible to tap my phone if it uses fiberoptic (FO) cable? FO cables don't connect individual phone lines to the telco switching office. They are used as "trunks," large cables that connect one SO to another. FO cables can be tapped, but this is difficult and requires some sophisticated gear and access to the cables.

A FO cable consists of a number of thin strands inside a sheath that would have to be opened from inside a telco junction point or inside the telco office. This is a very big deal. Once the cable sheath is opened, an individual strand could be separated from the rest and bent into a "V" or an "M" shape. Some of the light from the strand will escape from the bends, and this can be detected and amplified with a very specialized and hard-to-get device.

Even then, each strand inside the cable carries a large number of conversations at the same time. This is known as multiplexing: many (conversations) into one (strand). Finding one particular conversation is nearly impossible. Some new lineman's test sets that just became available can tap into fiberoptic cables and communicate with the central office, but they cannot demultiplex (or, find) one particular conversation.

WHAT TO DO WHEN YOU FIND A BUG

If you find a listening device or something you think might be, first of all, leave it alone for now. Don't say anything to alert the listener that you have found it.

If it is a microphone, make some noise to cover the continued search. If it is an RF transmitter, shield it temporarily with something metal, and never assume that it is the only one. Always assume that there are others.

Look Again

A few years ago I saw a TV movie in which a crook bugged an FBI agent's home (how's that for a switch?) with several devices that included an FM wireless microphone. It was "found" by a neighbor whose FM radio picked up the agent's wife.

So this TV agent reasoned that this was the work of a real pro: using an easy-to-find device as a cover for another one. That's TV. No experienced spy is going to make a listening device easy to find. Even if there are twelve bugs, all will be as difficult to locate as possible, depending on access, what is available, and other variables.

When you are convinced that you have found everything, put things back the way they were and have a pro look over the situation.

Make a Profile

Once you have found a listening device, probably the first things you will want to know are who put it there and why. Generally knowing whom will tell you why. Let's take a look at some ideas on finding the spy.

If it is a battery-powered transmitter, estimate how long it will last. While it is possible for the spy to get in periodically to replace the batteries, this is not usually the case—spies want to get in and out and not come back.

What has happened or is about to happen in the room where it was found, within the time it will still operate? An important meeting? A deposition?

Consider also where it was placed and how long that would take. If the offending device was hidden under a desk using double-sided tape, it could be someone who was in the room only once and who was alone or unwatched for just a few seconds or created a diversion by pretending to drop something or look through an attaché case for some documents.

If, while interviewing someone, you received a call that you left your office to take, consider that the client may have arranged this call to give him or her time to hide the device.

If it was inside of a hollowed-out book that replaced one of yours, this tells you that either the person who placed it was in your office at least twice (once to get one of your seldom-read books and the other time to replace it after the bug was emplaced) or he knew your profession well enough to know that you would you have this book but seldom use it, which means one visit was sufficient.

If it was inside a hollow door, wall plug, light fixture, or other similar hiding place, then whoever placed it had to have access and be left alone for some time. Has there been any remodeling done in the area recently, during which a workman could have installed it? It could be the work of someone who broke into the office or room. If you have security personnel at the doors of your office building and secure locks at home then it was most likely an inside job.

Who could have been alone for the amount of time required to place the device? What do you know about them? Who cleans the offices and empties the wastebaskets? Do you have the carpets steam-cleaned on a regular basis? Who does it? Who of these people would have reason to bug you or might have been paid to install a listening device?

Now consider the degree of sophistication of the device(s). A $20 FM wireless microphone can be purchased by anyone who has twenty bucks. These are of poor quality, compared to the more exotic and expensive types, and, although they do work, they are more likely to be used by someone who has limited knowledge or funds. This is not an absolute, but it is likely.

On the other hand, officers of a well-known religious organization with assets in the hundreds of millions relied on a cheap FM wireless microphone to bug an IRS conference room. They sat in a car outside the building and listened on the radio.

A small bug hidden inside an upholstery button is usually the work of a pro because these devices just aren't that easy to get. The presence of the upholstery bug also means that the installer had to have been in the room at least twice, once to snip a tiny sample of the material to match and once more to install it.

A repeater system, likewise, will be the work of a pro or the government. Getting someone into a window-washing or maintenance crew to place the repeater on the wall of a tall building takes some connections or a bribe.

The use of an obviously homemade bug tells you a little about the person who planted it. It isn't likely to be the feds, and a pro would probably buy rather than build or do a neater job.

If it is built on an etched circuit board that looks sloppy, has traces that are crooked or uneven, or is built on perf board (a thin Bakelite sheet with holes drilled every 1/10 inch), and the solder joints are sloppy, it was probably made by an amateur. The more professional bugs will likely be inside a metal shield so as to be missed by the NLJT.

Consider the probable range of the device, based on output power, antenna size, and where in the room it was placed (if near a window, which one and which direction does it face?).

The power output of the cheaper wireless microphones may be only 10 milliwatts or even less, with a probable range of 100 feet under the best conditions. The range of more expensive units, $50 and up, is about five times as high. This is useful in trying to determine where the listening post is.

Is there a way to trace it? Probably not, but the FBI crime labs are capable of some incredible things. Omnibus is a federal law so the FBI has jurisdiction over its violation. There is a slight chance it could be traced back to whomever installed it. It's worth a try. Put all this information together and see what kind of profile you can build of the person who bugged you.

Make a Plan

Using the profile, decide how to proceed. You can disable the device, feed the listener misleading information, or try to draw him out, either to catch him and try to have him arrested or otherwise dealt with, or to find out who he is and, in turn, bug him.

Deciding how to proceed is dependent upon your situation, but consider feeding the intruder information about something that will be sure to cause him to react. If you say something that causes him to believe that something important is about to take place—a meeting at a location you disclose—the listener may show up to see what he can find out.

The location of such a meeting should be in an area in which it is easy to look for people; the more secluded, esoteric, and important-sounding, the better.

Arrange to have someone get there early and look for known people, write down license numbers, take photographs, etc. See who fits the profile. If one of the license numbers comes back to a carpenter or firm who remodeled your office, a client, or a competitor, you know where to begin your plans.

Destruction of Bugs

Once again, consider whether you want the person who has placed the device to know you have found it before you destroy or disable it. An inside bug can be removed or the battery disconnected. Rather than destroy it, keep it as possible evidence.

If the phone line resistance measurements indicate a bug is attached and you cannot locate it by following the phone line, it can be burned out by sending a burst of low-current high voltage down the line. Burst units are available from some of the suppliers we have listed, and they are very simple to make, but as this involves high voltages and the possibility of damaging the telco lines, I suggest that you have this step done by a professional technician.

PART IV

OUTSIDE DEVICES

Whereas the first three parts of this book were concerned with inside listening devices, part four deals with ways to listen to conversations from a distance without having to enter the area to hide a bug or tap a wire, and one type of microwave bug that is both inside and outside.

Outside listening devices can be active or passive. A shotgun microphone doesn't do anything but listen; it is passive. A laser emits a beam of light; it does something and, thus, is active.

Parabolic Reflectors and Shotgun Microphones

Microphones can be omnidirectional, designed to pick up sound from all directions, or unidirectional, designed to pick up sound from one direction only. However, even unidirectional ones pick up some sound from all directions.

To make a microphone highly directional, it is necessary to place it inside something that narrows or concentrates sound. The first of these is the parabolic reflector, which is much the same as a TV satellite dish on a smaller scale. It can be as small as a few inches across, such as the one made by Tyco as part of its line of Spy-Tech toys (which really works) to a typical hand-held plastic 18-inch model, which works much better than the toy one, to the four-foot tripod-mounted model from CSI.

Sound waves that strike the dish are concentrated and reflected to a focal point where the microphone element is mounted. The problem with parabolic reflectors is that they tend to pick up sound from the back and are not as able to zero in on someone as the shotgun type.

The shotgun microphone uses one or more long tubes to narrow the area in which it will pick up sound. Neuman makes a shotgun that sells for about $1,200, which is used by broadcasting companies and TV sports reporters, who can afford whatever they want. Another good shotgun mike is made by Sennheiser and sells for about $550.

Shotgun microphones that use more than one tube are sometimes called "Gatling guns" because of their resemblance to the early machine gun. This type of mike was used in the movie *The Manhattan Project.*

A Gatling gun microphone is easy to make. It requires lengths of aluminum or stainless tubing of about 3/8-inch diameter and starting at 1-inch and increasing in 1-inch increments up to 36 inches or so. Bundle these together, with the flush ends covered with a metal or plastic housing that contains the microphone element and is filled with sound-absorbing material. The tubes have to be straight; if slightly bent, they don't conduct the sound as well and can cause distortion.

The performance of any of these directional microphones can be improved by using an equalizer, the same type used in stereo systems. Most microphones will "hear" from about 50 to 20,000 cycles or so; some hear higher, some not as high. The 300 to 3,000 cycle bandwidth used by telephones is more than sufficient. What is missed at the time because of interference can, to some degree, be recovered from a tape recording using the equalizer.

The only way to detect either type is by seeing it, and if the user has it hidden behind acoustically transparent material (e.g., thin curtains or the grille cloth or foam used in speaker systems), it isn't going to be seen.

While outside, not much can be done to avoid being heard by a directional microphone, but at home, neither type can pick up much through closed windows and drapes, and there are only so many places within effective range to hide a four-foot dish or a four-foot Gatling gun.

Although both types work, they cannot zero in on one person in a crowd from a hundred yards away. They can focus on a small group of people from a hundred feet or so, but they cannot pinpoint specific conversations any more reliably than that. And neither mike can hear the spekaer very well if he is facing the opposite direction.

MICROWAVE LISTENING DEVICES

Besides the microwave frequency bugs from an earlier section, there are other ways to use microwaves for surveillance. The first method is to concentrate a microwave beam on something that vibrates from the sound in the room in which it is placed. The reflected beam, coming back, is converted into sound, like the laser devices detailed in the next part.

In the U.S. Embassy in Moscow, the sculpture of the American eagle that the Soviets presented as a gift was made so it would act as a sounding board for reflecting microwaves. Beware of bears bearing gifts. In addition, the steel rebars (reinforcement bars) inside the concrete walls were arranged in such a way that they would also reflect the microwave beam, just like the eagle.

The second method, used both outside and inside, is to plant a small device called a resonator, which looks like several quarter-size metal disks with a small rod through the center, inside the area to be bugged. The resonator may be inside a small metal cylinder. A microwave transmitter is placed somewhere near the target on one side, and a receiver goes on the other side. A concentrated beam from the transmitter is directed at the point where the resonator is hidden.

This device is vibrated by sounds in the room in which it is placed and modulates the microwave beam. When the receiver picks it up, it can demodulate (recover) this sound. This device is *very* expensive and therefore *very* unlikely to be encountered.

Another system that some scientists in Germany are working on will supposedly reflect the microwave beam from the changing density of the air—sound makes tiny compressions in air, and this system is supposed to convert this change in density into sound.

The principle that this works on is probably similar to one that produces laser holograms. The laser beam is split into two smaller beams. One of them is bounced off a mirror that changes the phase angle, and when the two beams are recombined, they create an image in space. Unlike the lasers in the next part, microwaves penetrate walls and don't require a window. Also, they are unaffected by the things that can interfere with lasers.

FINDING MICROWAVE DEVICES

The operating frequencies of such microwave listening devices can be anywhere in the microwave spectrum, from 3 to 300 gc., but the types that can carry voices are more or less limited to a maximum of 23 gc., which some spectrum analyzers will detect.

All of the microwave engineers I interviewed said that they were not aware of any type of transmitter used for voice transmission above 23 gc. That area is used for telemetry, radar, deep space exploration, and satellites, and the transmissions are nonvoice: pulse code modulation, multiplexed signals, and so forth.

The chances of such a system being used on you are slim. They are very expensive and require skilled people to set them up and operate them; they are primarily used by the federal government. Unless you are very important to them, there is little chance of their using this against you.

Special microwave receivers are available that tune the area, such as one made by Condor Systems in Silicon Valley. The spectrum analyzer will also detect microwave transmissions.

The names of other manufacturers of microwave surveillance receivers are in the list of suppliers in Appendix C.

LASERS: HOW THEY WORK

This method of eavesdropping was allegedly devised by CIA. A laser and a telescope are mounted on a tripod, and the laser beam is pointed at a target window. Part of the light beam passes through the glass, and part is reflected back to the telescope.

This reflected beam is "seen" by the telescope, and the light from the eyepiece is focused on a photocell that turns variations in the light into electrical impulses. These are converted into sound and amplified so the listener can hear it.

The target windows vibrate slightly from the sound inside the room, and this tiny difference in the distance from the laser to the window produces the variations in light that are recovered as sound. It is just that simple—in theory.

The laser has to be placed so that the target reflects the beam exactly back to the telescope. If the angle is not very precise, the reflected beam will miss it. Theoretically and under ideal conditions, it can hear clearly what is being said in the target room from miles away, but many things can interfere with reception. Dust, fog, rain, street noise, passing aircraft, vibrations in the target building (including elevators, heavy equipment in the basement, anything that can interfere with the beam or cause the window to vibrate) all considerably reduce the effectiveness of the laser listening device. Good-quality audio-filtering equipment can improve the system somewhat, as can using a different type of laser, but it is still far from perfect.

The obvious reason for using a laser for surveillance is that no penetration (entering the target area to install a listening device) is required; the listener doesn't have to go anywhere near the target.

Because lasers don't work that well most of the time, practitioners have devised a way to improve this method that requires the spy to get close to but not inside the target. A small contact microphone is placed in the corner of a window where it is least likely to be seen. A thin wire is used to lead to an audio amplifier hidden nearby, which, depending on the amount of space available, has a large long-lasting battery. Then the audio from the amplifier goes to a speaker that is mounted on a thin glass plate. This is placed inside a specially made case that absorbs vibrations that would interfere with reception. The laser is focused on the glass plate, which the speaker causes to vibrate, just like the windows, and is reflected back the same way. This improves reception considerably and can still be used from a long distance.

A semitechnical explanation of lasers might be useful here. Laser stands for "light amplification by stimulated emission of radiation." The principle of a laser is quite simple. The original ruby laser consisted of a small rod made of synthetic ruby (aluminum oxide and chromium) about 1 centimeter (cm.) in diameter and 10 cm. long, which is polished and mirrored on the ends, and a high-intensity light source such as a camera electronic flash unit, which is placed close to the rod. When the light flashes, some of the light enters the rod (which is called an optical resonator) from the sides. Some of the light strikes the mirrored ends and is reflected to the opposite end and then bounces back and forth. As it does this, it strikes some of the chromium atoms and causes them to emit more light particles (photons), and this process (amplification) continues until the intensity of the light is so great that the mirror on one end (which is slightly less reflective) cannot contain it, and it bursts out in a flash of red light.

Since the mirrored ends are nearly perfectly parallel, the beam is likewise parallel; it stays focused and does not spread out like other types of light.

Lasers can be made from a variety of materials such as glass tubes filled with various gases (helium, neon, carbon dioxide), liquids, or solids. They have even been made from Jell-O and vodka.

A laser that can change wavelengths is the "tuned dye" type. The lasing medium is a liquid that flows through the resonator, and as the color changes, the wavelength changes. These are expensive and usually are confined to laboratories, but they are being developed as a surveillance laser, to compensate for fog and dust, etc.

A laser that will work as a listening device can be purchased at surplus electronics stores for about a hundred dollars, but at that price it will be a helium-neon laser, the type used in supermarket check-out stands. It produces a bright red beam. If you point it at a window, someone will see it.

Invisible infrared lasers start at about $750 and are available from Edmund Scientific Company.

These are all low-power lasers; their output is a few thousandths of one watt. The types used by government agencies to spy are much higher in power, one watt or more. These types are very dangerous. If a person were to be hit square in the eye by such a laser, to quote an engineer from a company that makes them, "The first thing you would notice would be your eyeball exploding."

The telescope need not be anything fancy; a small, inexpensive Tasco, often found in pawn shops for less than a hundred dollars, works fine. The electronics are also not complicated: the IR receiver described elsewhere will work, and it is another device that any technician can build.

Before you go out and buy a laser to try this system, read a few books on lasers and safety, and keep in mind that when you point one of these concentrated light devices at someone, there is a good chance of causing eye damage.

FINDING LASERS

"If it can see you, then you can see it."

Kodak IR Detection Products and Sunstone IR converters are card-size devices that are charged by exposing them to normal visible light. Once charged, they will glow when exposed to infrared light. These devices are also available from Edmund Scientific Company.

The TD-53 bug detector that will find the IR bugs mentioned above will also locate a laser beam. Since the laser beam has to strike the target window at a precise 90-degree angle for it to work, it obviously has to come from a location that is at the same height as and in a direct line to the target, so it's not very difficult to pinpoint the source.

DEFEATING LASERS

The easiest way to prevent being listened to by a laser is to tape a small transistor radio to your windows. Tune it to a rock station and send the listener some good vibrations.

Naturally, this will alert your listener that you are protecting yourself, which you may not want to do. In that case, heavy drapes will make the laser useless, as will an air conditioner in the window or anything that causes the glass to vibrate. The "cone of silence" used by Maxwell Smart on "Get Smart" will also work. This is a little extreme for most people, but something similar was used in the U.S. Embassy in Moscow.

PART V

COMPUTER EAVESDROPPING

You are a psychiatrist who has just finished a session with one of your patients, and you are using your personal computer to transcribe and print your notes for the file. The patient is an electronics engineer who works for a company that makes nuclear weapons. He is psychologically incapable of having a "normal" sexual relationship, and the only outlet he has for his repressed desires comes from watching others doing what he cannot. He is a voyeur, a Peeping Tom.

A surveillance van is parked on the street several blocks away, and inside it is a modified TV set whose screen displays every word you type. Later, foreign agents follow your patient, watching and videotaping him through sophisticated night-viewing equipment. Then they confront and blackmail him into revealing classified information.

Like most people who have computers, you had no way of knowing that this is possible. There were no warning labels on the case or in the manuals, and the dealer didn't tell you because he didn't know.

TEMPEST AND VAN ECK TECHNOLOGY

We called twenty computer stores and talked to the sales people about van Eck and TEMPEST. Not even one of them had ever heard of it. TEMPEST is an acronym for Transient Electromagnetic Pulse Emanation Standard, which concerns the amount of electromagnetic radiation that is generated by computer terminals and monitors and the levels that are considered safe from eavesdropping by the van Eck system. These safe levels, or "standards," are detailed in technical report NACSIM 5100A, which has been classified by the National Security Agency.

More technical stuff: whenever an electric current changes in voltage level, it generates electromagnetic pulses that radiate into space like radio waves. In a computer monitor, as in a television set, an electron gun sends out a beam of electrons (electric current), and when these electrons strike the screen, they cause the coating on the screen to glow. This beam scans across the screen in a series of lines, from top to bottom, and "paints" the picture one line at a time.

As the electron beam scans, it flashes off and on to make the screen light and dark, and these changes in the voltage level generate the signal that the van Eck system receives. The base frequencies most monitors "transmit" on are from 50 to 75 mc., but they also have harmonics, multiples of the base frequency. For example, the EVGA monitor used with this system transmits a strong signal on 61.31 and 63.495, and the seventh harmonics are fairly strong in the 428 to 430 mc. area. If you have a personal computer and a scanner that receives this area, set it to search 52 to 74, and you will hear your monitor as a loud buzzing sound that changes whenever you punch a key. The range of 54 to 72 mc. is TV VHF channels 2, 3, and 4.

Why, you ask, don't I pick up my monitor on my TV set? The internal signals in monitors are different from those in television sets. To convert a TV so that it will receive a monitor, one must generate these signals and inject them into the TV as "composite sync" or synchronization.

The system that does this is known as the van Eck technology, which is the result of research done by Dr. Wim van Eck at the Neher Laboratories in Holland. He conducted a demonstration of his new system, which is detailed in publications listed in Appendix I.

The van Eck device is not especially complicated. Any electronics engineer can design it, and anyone familiar with digital electronics can build it. It consists only of a small circuit board, a dozen integrated circuits, and a few other components, all available at commercial electronics or surplus stores.

The device is usually built into a small black and white TV with a very directional antenna connected to it, and it can receive a monitor from half a mile away or so. The TV screen will display whatever is on the target computer, and it can be stored on videotape.

A schematic diagram of the van Eck snooping device is available from Consumertronics.

DEFEATING VAN ECK

I do not know if using van Eck technology is legal or not. Omnibus prohibits "intercepting a wire communication," which computer data is not. Omnibus also makes illegal the use of any "electronic, mechanical, or other device to intercept any oral communication," which computer data is not.

Possibly, it would cover interception of data if the computer were connected to another computer by phone line, because it would be intercepting a wire communication that is part of an interstate wire system, the phone lines.

Anyone with the funds and the desire can set up a van Eck system in a van and roam around to see what he can find, and there is no way to detect them with electronic equipment.

Since there are people who can monitor your monitor, start by not using your system to process anything sensitive, if you can avoid it, until the system is secured. If you transfer data over the phone lines, encrypt it.

SECURING METHODS

The government spy agencies have many of their computers located in underground rooms, where they are secure from van Eck systems.

Those that are above ground are often inside vaults, as in the book and movie *The Falcon and the Snowman*. These are Faraday cages, which have heavy copper-mesh shielding that prevents radiation leakage.

Such methods are a little extreme for the average person or small business, but Wang manufactures computer systems that are secured against the van Eck eavesdropping method. A Wang VGA 386 system sells for about $5,000, compared to an IBM-clone 386, available for $2,000 or so at many computer stores. But this is a small price to pay for secure data.

Wang's TEMPEST secure systems do more than just shield the computer to stop it from transmitting; they are designed and built in a different way. That's all Wang would tell me. To buy one, you have to "show some ID" and sign statements about not exporting it to a foreign country. National security . . .

If the Wang is too expensive or doesn't fit your needs, you can make your system less susceptible to van Eck eavesdropping. TEMPEST radiation comes mainly from the monitor but can also be detected from the other parts of the system: keyboard, cables, printer, and the motherboard.

The monitor can be shielded by placing it in a metal housing. A 16-gauge metal box made by a sheet metal shop that is grounded provides a good start. All cables should be shielded (some already are, but ribbon cables are not) and grounded, and the metal computer case should also be grounded.

Once this is done, use a scanner to see if you still hear it. Move the scanner farther away and try it again. Now check the harmonics.

A good scanner has a sensitivity (in the VHF and UHF bands) of one microvolt or less. If the scanner cannot hear the monitor across the room, then a van Eck device isn't likely to hear it from across the street.

Having two monitors of the same type operating in the same area may confuse a van Eck system. Use a scanner to check both of them to see if they are transmitting on the same frequency. If so, then keep both running at the same time.

Keeping the brightness up and the contrast down slightly reduces the strength of the TEMPEST radiation, and anything metal between the monitor and the outside walls, such as filing cabinets, also helps.

Elenco Electronics has a TV jammer that transmits a signal on the same frequencies as a monitor. It comes in kit form, has less than a dozen parts (including a premade circuit board) and instructions, and costs just $6. This is another project that electronics students often build as a lab exercise. They could easily add a one-transistor amplifier to increase the power, which should jam a van Eck listener very effectively.

COMPUTER DATA ENCRYPTION

It wasn't that many years ago that computers were available only to the government and big businesses, and only they could encrypt data to keep it secret. Then, in the seventies, this changed. The Apple II and IBM PC hit the market, and almost anyone could afford to buy a computer.

Suddenly, massive amounts of information were being stored in very small places and being transferred through the phone lines all over the world. This placed such information at great risk, as it is a little easier to steal a floppy disk or two than a filing cabinet, and tapping phones isn't terribly difficult. A way to keep confidential information confidential had to be found.

A number of old "pencil and paper" encryption schemes were quickly rewritten into computer programs, and now anyone who had a computer could encrypt information and keep it private—something that certain government agencies didn't like very much.

There are a number of these programs, that provide varying degrees of security, from modest to literally unbreakable, and costing from nothing to several hundred dollars. The two most important, and secure, programs are the RSA and the DES.

THE RSA PUBLIC KEY SYSTEM

The problem with most encryption systems is not that someone will be able to crack them; it is key distribution. In a business or government agency, there are certain people who have to have the key to access to confidential data, and there is always the chance that, as it is passed from one authorized person to another, it might fall into the hands of someone who is not authorized to have it—such as a spy.

The answer to this problem is the public key system. The public key system uses two keys or passwords. One is the public key, which can be made available to anyone, and the other is the private key, which the person using the program keeps secret. Having someone's public key does not weaken the system or make it possible to derive the private key.

If someone wants to send a secret message to someone else, he uses that person's public key to encrypt it and then send it to him. Only the recipient can unscramble it by using his private key, so the problem of key distribution is eliminated.

THE DATA ENCRYPTION STANDARD

The Data Encryption Standard (DES; Project Lucifer) was developed in 1977 by IBM for the National Bureau of Standards (now the National Institute of Standards and Technology, or NIST) and the National Security Agency and is still a formidable method of encrypting data.

As originally written, it encrypted data in 64-bit (8-byte) blocks, but this was later changed to 56 bits—the government wanted a program that only it could break with its multimillion-dollar supercomputers, but 64 bits was too difficult for even federal agencies. These 56 bits of text can be arranged in any of 2 ^ 56 possible combinations, which is 7.2 x 10 ^ 16 or 72,057,000,000,000,000.

DES PROGRAMS

The Private Line DES

The Private Line (version 6.0, April 1988) is available from Everett Enterprises of Springfield, Virginia, for approximately $49.99. It is menu-driven and very easy to use as no knowledge of programming is required. Just follow the instructions.

It allows the user to quickly switch DES modes[1] from ECB to CFB to CBC, the documentation is well written, it also has the secure-erase[2] feature, and the user can select the number of passes. TPL allows the user to "double encrypt" file, using two different keys, which greatly increases security.

Some other nice things TPL has: it will output the file in ASCII for transmission over phone lines or LANs; you can view the file in HEX; it has a print option; and it has a built-in routine that performs the 171 tests that are required to ensure that it is in compliance with the original DES algorithm.

SUPER CRYPT DES

"Super-Crypt" (version 3.0, December 1990) is available from Super Software for around $59 plus postage. Super Crypt is also menu-driven (has nice pull-down menus) and is also very easy to use—just follow the instructions.

When you open the program, it prompts you for the subdirectory of the file(s) to be encrypted, which then appears on the screen.

Then you can select multiple files to encrypt and which of the two levels of security you wish to use. The program even tells you how long it will take. Both of these are very nice features.

It also has secure erase (the user can select the number of passes) and has the option of automatically deleting and secure-erasing plain-text files after they have been encrypted.

PUBLIC KEY PROGRAMS

MailSafe

The public key program "MailSafe" is available from RSA Data Security, Inc. for approximately $125. MailSafe is menu-driven and is the easiest of the public key programs to use. Generating the two (public and private) keys is done by simply following the prompts on the screen.

Once this is done, the main menu is accessed, the desired operation is selected, and the file to be encrypted or decrypted is easily called up by moving the light bar and hitting the enter key.

MailSafe not only encrypts messages, it has other features that make sending data even more secure. Two of these are the "digital envelope" and the "digital signature."

The MailSafe Digital Envelope

Suppose Alice decides to send a secret message to Bob. First, she encrypts the message with the DES, using a random key, and then she finds Bob's public key, and uses it to encrypt the DES key. The encrypted document and encrypted DES key are combined to form the "digital envelope" and sent to Bob. Only Bob can decrypt it, using his private key, to get the DES key, which is then used to decrypt the original message.

The MailSafe Digital Signature

Now to create a "digital signature" (which will authenticate the sender): Alice runs her document through a "hashing algorithm," which produces a "message digest," which is unique to each document. Then she uses her private key to encrypt the message digest, which produces the "digital signature" and sends it along with the document to Bob. When Bob receives this, he uses the same hashing algorithm to create a new message digest and also decodes Alice's message digest using her public key. Then the two message digests are compared. If they are identical, then the digital signature is authentic and has not been tampered with.

RSA works both ways. If a message is encrypted with someone's public key, it can be decrypted only with that person's private key, or if that person uses his private key to encrypt the message, then only his public key can decrypt it.

THE IRIS PUBLIC KEY PROGRAM

IRIS is a shareware RSA program that can be downloaded from some computer bulletin boards. It also has the DES and several other encryption programs such as Bazeries, Playfair, and Enigma.1

The present version of IRIS is not menu-driven, but a new soon-to-be-released version will be. It is produced in England, and using it in the United States requires a license from RSA Data Security, Inc.

HOW SECURE ARE THESE PROGRAMS?

The Data Encryption Standard

The world's fastest computer, the thirty-million-dollar Cray YMP supercomputer, can make more than two billion "flips," floating point instructions per second. If each of these calculations could try one of the possible DES combinations, it would take about 417 days to try them all. If the information was double encrypted, it would take years. The government would have to be very interested in the information to tie up one of its (many) Crays for that long. It has better things to do with its time, such as spying on library patrons and antiwar demonstrators.

For years there have been rumors circulating in the intelligence community and on computer bulletin boards and networks that the DES has "been broken"—that it has a "trap door," a secret way of breaking the code, that only the government knows about. When you consider that the DES was written FOR the government, I wouldn't be at all surprised (the feds are not above such trickery), but the source code for the DES has been available for years and has been examined, tested, and taken apart by dozens of expert programmers. If this were true, the world would know about it.

The RSA Public Key System

The RSA public key system is the most secure encryption system that is available to "we the people."[3]

First of all, RSA can use a longer key. The DES key is only 56 bits long, but the key length of the RSA algorithm is almost unlimited. A 250-digit key length would make for more than 10 ^ 200 possible ways to arrange a block of text. Numbers with exponents that big are beyond comprehension to all but mathmeticians and the Treasury Department.

The Cray YMP would be able to break the 200-digit key in about two million years. Maybe. If key distribution is not a problem, then the DES is secure enough, but if you are in a situation in which the key has to be made available to a number of people, then obviously a public key program is indicated.

Keep in mind that if you use the RSA or DES to encrypt something, you must not lose the key. If you do, your data is gone forever. There is nothing anyone can do to get it back.

THE PAK-RAT EXPERIMENT

I would like to hear from anyone who has tried the following experiment, which I conducted last year (write to the author in care of Paladin Press, P.O. Box 1307, Boulder, CO 80306). I used an AT (286) computer with a clock speed of 10 mc. and a Casper TTL amber monitor, a high-frequency receiver, a Toshiba portable computer, and a Pak-Rat II decoder.

I started a program that converts text on the screen to Morse code, and while the speaker was beeping out the listings of the hard-disk directory, I tuned the receiver to a number of frequencies from 442 kc. to 20 mc. (A scanner that covers 50 to 75 mc. was not available at the time). With the receiver feeding into the decoder and the Toshiba, it printed on its screen the same information that was on the screen of the AT.

I moved the receiving equipment to a motor home parked in front of the house and set it up to run on the generator. By using a small whip antenna, I got the same result. I don't know which of the many signals in the computer I was receiving or if it was a subharmonic of the monitor, but it did work.

The decoder is too slow to work with a normal program running on the main system, but if a much faster ASCII decoder were available, it might work. This would be an improvement on the van Eck method as the received information could be stored on disk and would not require the use of a VCR.

TYPEWRITERS

Some electronic typewriters also generate electronic pulses that can be detected and converted to reveal what is being typed. They should be shielded and grounded to protect sensitive data that you don't want others getting their hands on.

IBM Selectric typewriters, which are not electronic, have to be modified internally to radiate a signal—or so I have been led to believe.

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[1] These programs will be detailed in my next book, which will have a long and comprehensive chapter on encryption, computer hacking, and security.

[2] Secure-erase writes over the old plain-text file so it can never be recovered.

[3] A number of big companies such as Novell, DEC, Lotus Development Corporation, Motorola, and Microsoft use MailSafe. These places have umpteen software engineers and programmers per square foot, many of whom would have checked it out thoroughly before trusting it. If there were a "trap door" in MailSafe, they would have found it long ago, and RSA Data Security, Inc. would be long gone.

PART VI

VIDEO OPTICAL SURVEILLANCE

A person can be under video surveillance at work, on the street, in a car, anywhere he or she goes. Retail stores, banks, airports, parking lots, shopping centers, and drive-up windows all have video cameras. The lenses inside cars or vans can be disguised as reflectors or mirrors or as specially made periscopes that look like air vents. People can even be under video surveillance in their homes and offices and not know it.

Pinhole lenses that allow surveillance through 1/8-inch holes can be disguised as sprinklers, and very thin fiberoptic probes can peek through keyholes, under doors, through the openings in wall plug covers from adjoining offices, light fixtures from upstairs apartments, or through other small openings. Or an opening can be made.

A forgotten briefcase can contain a camera that will transmit to a neighbor's house, a nearby apartment, or a van parked on the street.

AVAILABLE EQUIPMENT

The latest thing in video surveillance is a very small, self-contained camera and transmitter from Interphase. It is 2.8 x 1.6 x 5.6 inches. The 100-milliwatt transmitter will send the signal 100 feet or more, depending on conditions. Fascinating.

Infrared night-viewing devices allow surveillance in total darkness by emitting a beam of IR light, and starlight scopes use ambient starlight amplified by a photomultiplier tube or other device to "see" inside dark rooms if the curtains are open. Edmund Scientific and Sherwood offer such night-viewing devices.

DEFEATING VIDEO SURVEILLANCE

Inside video surveillance is not difficult or expensive to prevent. The easiest way is to repaint around any place where there could be a small opening, such as ceiling light fixtures, and plug the wall outlets as with the tube microphones in Part I.

A careful physical search will uncover a hidden camera or the lens, and there are video camera detectors that pick up the signals that cameras generate. Capri has one that uses a directional antenna.

Fiberoptic probes are flexible and can be worked through small holes behind cabinets, bookshelves, or other furniture if the person using them knows the layout of the target room. What (and who) is on the other side of your walls?

Check air vents and hot air registers, both favorite hiding places. If you find a pinhole lens opening, you can simply cover it with tape, or you can buy a laser that will disable the camera it is connected to at electronics surplus stores for less than $100. Poetic justice, I think.

Keep blinds and drapes closed, place a felt strip on the bottom of doors, and block any opening through which a lens can look, and no one will be able to use video devices against you.

Should you find a camera, you can disable it or leave it in place and feed it misleading information to draw out the person who placed it. Even though pinhole lenses can see through such small holes, the rest of the equipment is much larger. In a home, there aren't many places to hide it and to do so requires access and time, which make it more unlikely.

Video equipment is also expensive. Surveillance cameras alone run $300 to $1,000; a pinhole lens costs several hundred; a transmitter to send the signal can cost $2,000, plus a monitor and VCR. It gets rather spendy.

Those who can afford to install such equipment realize that the victim might find it, so they have to accept the loss. You find it, you own it.

There is absolutely no reason anyone should have to be under video surveillance in his or her own home.

TWO-WAY TELEVISION?

People have asked me if it is true that a TV set can "see" the people who are watching it. A TV, as with many other things, can have a small video camera hidden inside it.

But can a TV set, as it is manufactured, watch you? Is this some secret way for the government to spy on you? The answer is no. I spent three unexciting terms in college studying the boob tube, and I know what is inside them.

What about a cable TV converter box? Yes, a video camera could possibly be hidden inside your converter, but it isn't likely. First of all, there isn't enough space in most of them. Even if there were, it would take hours to install a camera, which means someone would have to have that much time in your home or office or be able to switch yours with one that has a camera.

The spy would have to know the type you have (there are many to choose from) and then duplicate any identifying marks on your converter that you are used to seeing. He would also have to be able to program the converter for the same premium channels. If he did not do so, when you turned to HBO to watch a movie and found no HBO, you'd call the cable company and raise hell. The customer service representative would tell you that your HBO *was* on, the next day you'd return the converter and get another one, and the spy would be out several thousand bucks.

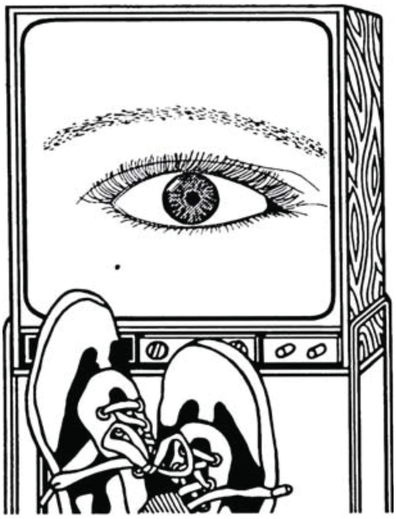
The last drawback to using a cable box to spy on you is the fact that such a camera has a range of no more than a few hundred feet, which limits the area available for a listening post.

It isn't likely that someone would choose to watch you from the cable converter, but it is possible. If someone did bug your cable, there is a nifty way to defeat it. The Powermid system from the Heath Company is basically a device for using an infrared remote control to control something in another room. It relays the signal from the remote control. Hide the cable converter behind the TV set where it can't see anything and use the Powermid. If you are the feisty type, tape a few hours of commercials, point the converter at your TV, and play them back.

Another way to defeat the spy's setup is to set the converter so it points at a wall and place a small mirror on that wall. Bounce the beam from your remote control off the mirror so the cable box will still work.

Could the camera send a signal through the cable to the cable company, or to someplace where a spy has tapped into it? Yes, it could. Cable TV companies can send many channels through one wire because each channel has a different frequency.

A spy (a very high-tech spy) could modify the camera's transmitter to work on an unused frequency and watch it on his own set with a modified converter, but the cable company would prob-



ably notice this very quickly. Then it would send someone around to find out what was going on and ask some rather hard-to-answer questions.

As far as the cable company using converter boxes to spy on customers, it's not likely. It would have to arrange for you to get one of the converters with a camera in it, either by having someone break in and switch boxes or by having someone come to your home and tell you that the one you have has been "recalled by the factory" or some such story. If two unsmiling cable employees wearing suits show up at your door with a new converter, be suspicious.

Seriously, if cable companies began to use such an insidious method of spying, they wouldn't be able to keep it secret for long, and when people found out, the loss of subscribers would put them out of business. No one is that addicted to The Disney Channel.

Finally, there is the cost. Who is going to go to all this trouble and expense just to watch you watching the tube? It's too much money for something that is so hard to install and easy to defeat.

What about audio surveillance through the cable system? This is easier and much cheaper than video and certainly possible, but, again, it is farfetched. The same factors that make it impractical for an individual to watch you through the converter apply to his listening to you. And if a cable company is not willing to risk watching you, it's not going to listen in. But just in case, if a microphone were used in the system, it could be defeated by blocking all the openings in the case. You can also take it apart and look.

Since the converter is usually placed on top of the TV, the sound from the speaker would partially block what it was trying to hear so the microphone could be hidden in the remote control. Again, take it apart and see. Or install a small slide switch to turn the battery off when you aren't using it.

I seriously doubt that cable TV is being used for surveillance, but one way to be 100 percent sure is to kick the TV habit. Rent videos or, better yet, get a library card. They're free.

PART VII

OTHER SURVEILLANCE METHODS

Believe it or not, there are even more ways for those who wish to know your business to spy on you. These include monitoring your mail, ultraviolet-sensitive chemicals that leave behind evidence of your presence wherever you go, bumper beepers, and electronic trackers.

RAIN, SLEET, AND GLOOM OF NIGHT

Your mail can be opened and resealed without your knowing it, using the techniques in the book, *CIA Flaps and Seals Manual* (available from Paladin Press). This book details methods of dry opening, steam opening, and resealing; using two knitting needles to wrap the contents in a tight spiral and then slipping them through the corners of the envelope where there is no glue; avoiding covert traps set by the sender; and much more. The book also has some good information on defeating these methods and makes for some interesting reading.

Opening a person's mail is illegal without a court order, but there are other methods spies can use. They can have the post office make copies of the front of the envelopes that you send and receive. There is no law against this, and as the saying goes, even though this might not tell someone what is inside an envelope, sometimes it's enough to know who is communicating with whom. If the government, or a spy who is paying off a postal worker, were investigating you, having the names of people with whom you are corresponding could open up a whole new approach.

Another trick is to spray a sealed envelope with Freon that makes the envelope transparent so the user can see some of what is inside. It disappears without a trace, much like the user.

Spray cans of Freon are often resold with different labels such as "secret formula letter bomb detection fluid," "X-Ray Spray," and so forth at a substantial markup—often in the $20 to $30 range. A 16-ounce can of Freon is available from Jameco for $8.95 and can also be found in some electronics supply houses; it is used for cleaning parts.

Using envelopes with a black pattern on the inside prevents this method from working, as will wrapping the envelope's contents in dark paper.

If you believe someone is tampering with your mail, arrange to have anything sensitive sent to you under a different name, in care of a friend or business associate. You can have letters mailed from a different city by placing them without a return address in a larger envelope and sending it to the postmaster in that city. If it is addressed and has the right postage, the post office has to try to deliver it.

I tried this by mailing five letters to five different cities, and I received all five. Four of them were postmarked in the place to which I sent them, but the post office apparently sent one back to the city from where I mailed it; it had the local postmark.

Also, consider computer bulletin boards. There are thousands of them all over America, and many are linked together in networks. Some of these permit encrypted messages. Compuserve, for example one of the largest and most expensive, has no restrictions on this. The "Fido" net forwards electronic mail all over the world and is usually free.

STICKY FINGERS

There are a number of chemicals that "glow" under ultraviolet light, such as calcium silicate, which produces an orange light, and zinc orthosilicate, which glows greenish yellow.

Mixed into a solution, they can be painted on any surface and will stick to the fingers of anyone who touches it and then rub off on whatever that person touches.

Businesses use them to see where their employees go when the boss isn't around, and in Moscow, the Soviets painted the stuff on doorknobs to follow U.S. Embassy staff.

These substances are available from places such as The Spy Factory and The Intelligence Group, or chemical supply houses. Anyone can buy them, and anyone can use them to "follow" you wherever you go.

BUMPER BEEPERS, LOJACK, AND CATS

The "bumper beeper" is a small RF transmitter that can be hidden anywhere on a motor vehicle. The name comes from the method of attaching it to the vehicle—a small magnet is attached to the transmitter, which adheres to the bumper.

The device emits a beep that is picked up by a "chase" vehicle. It has a special receiver with a rotating antenna to tell which direction the beep signal is coming from and a meter to measure the signal's strength. This device does not pick up voices, it only transmits the beep.

Lojack is a system for tracking stolen cars that was originally set up in the east, and is now installed in Massachusetts, Michigan, New Jersey, Florida, Illinois, and Los Angeles County.

For $595, the Lojack company will install a special type of transmitter in your car. Then, should it be stolen, the local police or the FBI can turn the transmitter on by remote control and track wherever it goes. This is a great idea for recovering stolen cars, but it could also be used by law enforcement to track anyone that has it. The Lojack system transmits on 908.000 mc.

A bug can be placed inside a car, just as anywhere else. One clever method someone thought of was to place the bug and a large battery in a stuffed toy tiger that gas stations used to give away. It could be quickly switched, and you probably would never know.

A bug hidden under the dash or rear deck would probably never be found and is easily wired to the electrical system. Since there is so much space available, it would even be possible to wire in a special circuit, including a transmit/receive (TR) switch and a sound-activated relay. If the car's radio or stereo system is not being used, the sound-activated relay will sense this and trigger the TR switch to connect the car's antenna to the bug to increase its range.

A bug could be hidden inside a dummy turn signal flasher, the dome light, a mirror, a sun visor—the possibilities are almost endless.

Like any other bug, it has to have an antenna of some kind, and this is especially true in a vehicle because the steel body shields the signal. Look for a wire with one end that is not connected to anything. Inside the trim around doors is a likely place for an antenna wire. A good automotive electrician can find wires that shouldn't be there.

1984

The following is considered by some as an "opportunity" for some people to remain free when they otherwise would be locked up. If the general theme of this book—freedom and personal privacy—has made itself manifest, then the reader can guess that I do not agree. It's like burning books—once it starts, where does it end?

A few years ago, an electronic tracking device was developed that worked with the telephone system. A small transmitter was built with an ankle or wrist strap attached that would register on the receiver connected to the phone when it was within range.

The purpose was to keep track of parolees, to tell if they were home when they were supposed to be. Use of this device was "voluntary." The prisoner either volunteered or stayed in prison. The strap was attached to the convict in such a way that if it was removed, an alarm would alert the parole authorities and police. This wasn't good enough for the keepers, and so a number of "improvements" have been made in this system.

Today, a person arrested on suspicion of a crime can be forced into the same deal as a convicted felon, i.e., "volunteer" to wear the tracking device or stay in jail for a year or so until the trial. This is part of the federal government's pretrial services system.

These "improvements" include electronic voice verification, a Breathalyzer to detect consumption of any alcohol, and a camera that can photograph the person wearing the device in his or her own home.

One day soon, anyone the government "thinks might commit a crime" might be forced into the same situation.

1984 is getting close . . .

PART VIII

PREVENTING SURVEILLANCE

Once an area has been made clean, there are many things you can do to help keep it that way. You must first consider how likely you are to be bugged and by whom? If you are not involved in any criminal activities such as drug dealing and are not a political activist who openly criticizes the present administration, then you aren't likely to be bugged by Big Brother. They don't have the manpower to bug everyone, and you probably don't have anything to say that they care about.

If you are not a person who has confidential company information—such as trade secrets or formulas or designs for a new product—or an attorney working on a big case, then big business has little reason to bug you.

No matter who or what you are or aren't, there is the possibility that someone who has become mad at you for some reason, either real or imagined, or has picked you at random because he or she had the opportunity, will bug you. Such persons are usually amateurs who use unsophisticated and inexpensive listening devices.

Your next consideration is how far are you willing to go to prevent being bugged?

SECURING THE AREA

The first step is to protect your property from spies the same way you would from any other intruders. Even if you aren't concerned about being bugged, the increasing number of burglaries is a good reason to do this.

A number of excellent books are available from Paladin on the subjects of burglary, breaking and entering, and lock picking that will tell you a great deal about how it is done and how to keep it from happening to you.

Start with secure locks. It has been said that locks do little more than to keep honest people honest. There is a lot of truth to this. There are dozens of brands of locks on the market, some of which can be opened with ordinary picks. While researching this manual, I read a few books on the subject of picking locks and then found a professional locksmith who agreed to let me try it.

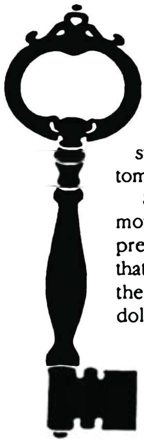
In his shop, he let me use a set of picks and a very popular brand of lock. On my first try at picking, I had it open in less than five minutes. I was impressed. He was not. He already knew how easy it is to pick some locks.

A much more effective device is the Cobra electric lock pick, which slightly resembles an electric toothbrush. It has a pick that is inserted into the lock, and when it is turned on, it vibrates the pins inside the lock up and down and a tension tool turns the core. It will open many locks in seconds—probably the one on your front door.

A set of lockpicks costs less than $20. The Cobra sells for about $225. Both are illegal to possess in most states but are available to anyone who has the money and is determined to get them.

The Cobra will not open an Abloy lock. Nor will anything else except the key. It is pickproof but expensive.

Some locks and some keys have a code number stamped on them. This number is used by a lock-



smith to make duplicates, which they will for anyone who has it. If any of your keys have numbers on them, have new ones made. Also look on the bottom of Master brand padlocks to make sure the code stenciled on the bottom has been scratched off.

Some doors can be opened by removing the hinge pins. This is easily prevented. There are special screws that can be used to replace the ones in the hinges, and they only cost a few dollars. Locksmiths and hardware stores have them.

The windows in the average home are often the weakest link. While metal-frame casement windows are very secure—they can't be opened from the outside without breaking the glass—the locks on double-hung windows are easily defeated.

The swing lock made by Belwith is available at any hardware store for less than $2. It is made for doors that open inward but can be installed on double-hung windows in five minutes and will prevent them from being opened from the outside.

Drilling a small hole at a downward angle in the window frames is another good method. The hole needs to go through the frame of the top half of the window and partway into the bottom one. Then place a nail in the hole, and it won't slide open.

Wrought-iron bars keep intruders out. Sliding glass doors are easily opened but can be secured with a dowel placed in the bottom of the track.

A PRISONER IN YOUR OWN HOME?

Alarm systems are good for scaring away some burglars, but an experienced spy knows that ringing alarm bells are often ignored for long periods of time. They can often break in, make the drop (plant a listening device), and disappear long before anyone comes around to investigate. We have all heard alarms ringing in a downtown or residential area without seeing anyone responding to them. It is far better to keep anyone from getting in than to depend on an alarm system to scare them away.

At home, one of the best deterrents is man's best friend, the dog. An aggressive German shepherd or Doberman that prefers spies to Alpo will give a would-be intruder second thoughts.

If someone does get in to hide a bug, a voice-activated tape recorder can be used to capture the sounds he made, which will tell you what he was up to. A hidden video camera is even better.

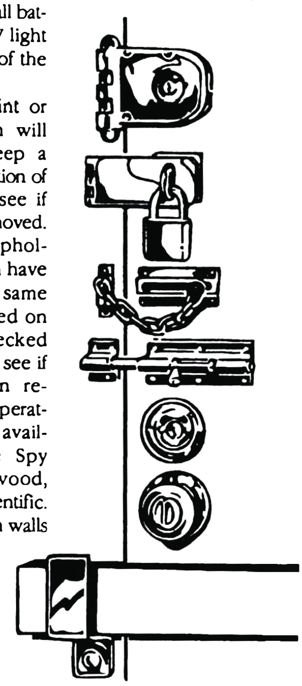
The Heath Company has a video surveillance camera for $300 and a video transmitter that will relay the signal to a VCR nearby for another $100.

You can also make it hard for an intruder to find a place to hide a listening device. Anything that can be opened and could hide a bug, as detailed in previous chapters, can be secured by painting over the screws with invisible solutions of the chemicals mentioned above that glow under UV light. Plastic covers on VCRs, switch boxes, phones, the backs of TV sets, and lamps make good targets. If these are taken apart, you can use a small battery-operated UV light to see evidence of the tampering.

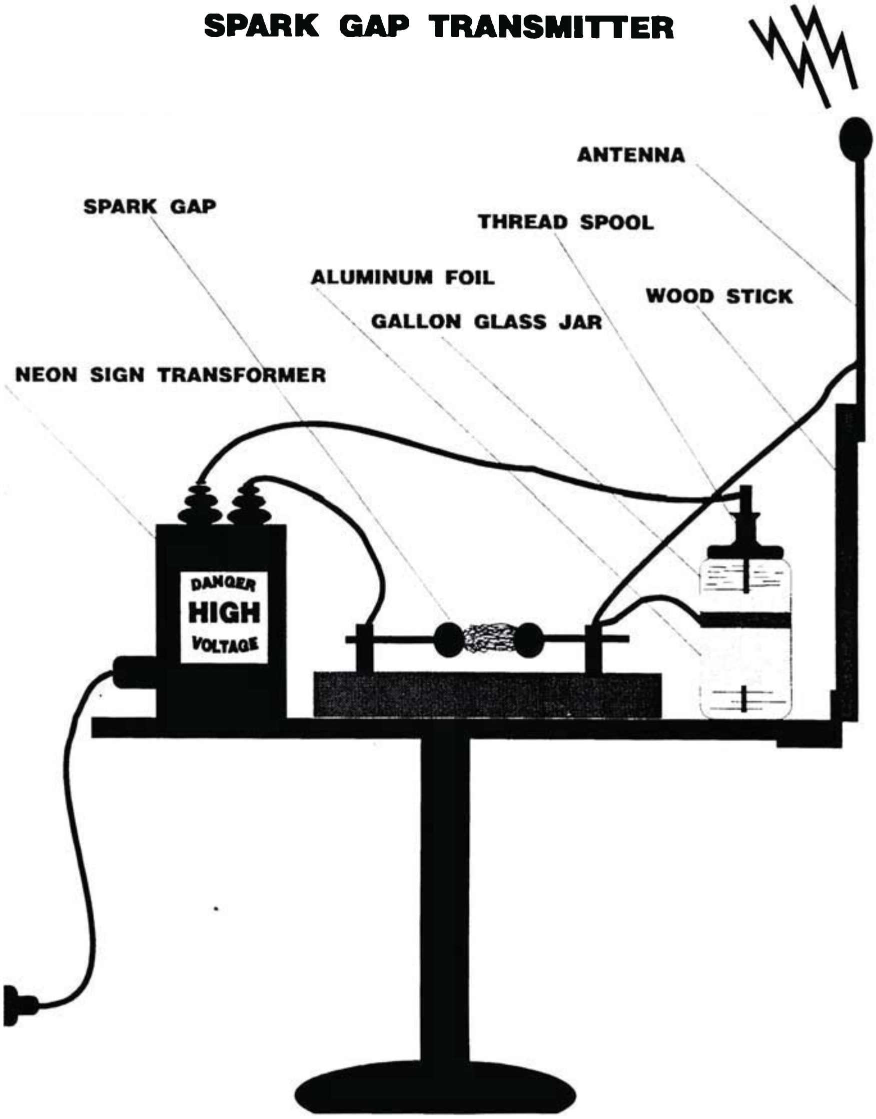
A dab of paint or fingernail polish will also let you keep a record of the position of such screws to see if they have been moved.

Books and upholstery buttons can have small dots of the same chemicals painted on them and checked now and then to see if they have been replaced. Battery-operated UV lights are available from The Spy Factory, Sherwood, and Edmund Scientific.

Small cracks in walls and openings between walls and windows or door frames, and the little plastic handles



"OLD SPARKY"
SPARK GAP TRANSMITTER



on venetian blind cords, all of which could conceal a microphone or small bug, can be filled with caulk, putty, or silicone sealer. This keeps out more than one kind of bug.

OLD SPARKY

Old sparky is the name sometimes given to spark-gap transmitters (SGT) used back in the early years of this century for communicating with ships at sea. It produces a loud buzzing sound that jams a receiver being used to listen to a bug.

Unfortunately, it also interferes with everything else, such as "Monday Night Football," which could make you very unpopular in your neighborhood. Used in a rural area where there aren't any close neighbors, it is an effective method of preventing RF bugs from working.

You can make your own SGT, but keep in mind that it uses 10,000 volts or more. This is at very low current, but it is still dangerous. You need the following materials:

- One or more neon sign transformers
- A one-gallon glass jar for each transformer, with plastic lid
- A pound of salt for each jar
- Miscellaneous junk-a-line cord for the transformers, some metal rods (such as old curtain rods), empty thread spools, and several feet of wire. Look at the diagram and improvise, using what is available.

Fill the jar(s) with water and stir in as much salt as will dissolve. Dry the jar carefully, wrap several layers of aluminum foil around it, and tape it in place.

Find a metal rod for each jar (some old threaded rod found in the garage will work fine) and insert it through a hole in the lid. Use an empty thread spool or whatever to hold it in place—the rod should not touch the bottom of the jar.

The spark gap can be made from two pieces of brass rod (1/4 inch in diameter) or two large bolts held in place on a small piece of wood, such as a 2 x 4. Make it so one of the rods can be moved back and forth to adjust the width. Start with a gap of 1 inch for every 20,000 volts used.

Wire it as shown in the diagram. The connection to the foil on the jar can be two turns with the insulation stripped off, or a metal band. The antenna can be a brass rod or whatever is handy.

When it is assembled, plug it in and watch the gap for a silver-blue spark. If there is no spark, unplug it and close the gap slightly until you get a spark.

One neon transformer is sufficient to jam bugs within a hundred yards. If you get carried away and use a dozen transformers, high-voltage plasma will be floating around all over the area, and someone could get zapped. The kid next door, for example, touches your screen door and gets bit. He goes home and tells his dad, who comes over and punches you out. A week later his wife has formed the first chapter of M.A.S.T. (Mothers Against Sparkgap Transmitters), and some congressperson sponsors a bill outlawing them without a federal license.

THE RF ROOM GUARD

The Room Guard is a device similar to a bug detector. It has a sensitivity control that is adjusted for the ambient (normal background) RF level in the room in which it is placed, and it triggers an alarm if this level is exceeded by someone bringing an RF device into the room. The Room Guard is available from Capri Electronics.

PHONE GUARDS

There are many devices available to help secure your phone lines.

- A privacy module locks out extension phones. The first phone that is picked up is the only one that works, keeping anyone from listening on an extension. This is also available from Capri.
- A listen-down amplifier alerts you to a hook bypass switch. This is the technique used by an infinity transmitter; it closes the phone cradle switch and turns on the microphone.

Any small audio amplifier works. The Electronic Rainbow has one in kit form for about $10.95. Hobby stores and new and surplus electronic dealers often have them already built for a few bucks more. Most of these little amps have the speaker attached, and all that has to be done to make it work is to connect two small capacitors to the input of the amp and to the phone line.

The device does not interfere with the phone, and if there is audio on the line when the phone is not being used, you can hear it and know that a hook switch bypass is in use.

- The digital voltmeter used in the REMOBS section is another inexpensive device for protecting your line. Place it on your desk where you can see it, and if anything should be attached to your line, it changes the reading and you'll notice it.

Such a meter can also be made to set off an alarm if the line voltage changes by a certain amount.

- A separate ringer, available from stores that sell telephones, can be placed on the line and a switch wired to the phone to turn it off or on. This electrically isolates it from the line and defeats a hook bypass switch. At first, you will forget about the switch, and when you answer, will wonder why no one is on the other end, but soon you'll get used to it.
- There are devices that prevent the line voltage from dropping to the off-hook level that stop a drop-out relay from automatically turning a tape recorder on or activating line taps when the phone is lifted.
- Last but not least, the Telcom Security Unit does most of the above and defeats or detects various types of line taps. It is available from Sherwood.

TROJAN HORSES

Beware of spies bearing gifts. If some anonymous or suspicious person presents you with something that could contain a listening device, check it out, and remember that almost anything can hide a bug. The most likely one would be a table lamp or something that plugs into a wall socket.

Be suspicious of packages with cards asking you not to open them until Christmas—especially if you receive them in July.

LOOK AROUND

Using the above devices or techniques will make your home secure from inside devices. Now consider outside listening methods.

You already know how to detect and defeat lasers, and keeping the windows closed and drapes drawn will defeat directional microphones, but in the summer people like to open their windows. An open window won't reflect a laser beam, but other things inside the room can, such as a mirror.

To use a directional microphone the listener also will probably have an open window. Probably the smallest one available will be used, but it has to be as big as the reflector. If he can hear you, then you can hear him. The Gatling gun device discussed earlier can be built for under $200.

One way to use a parabolic is to leave it in plain sight. A neighbor installs a 4-foot dish on his roof, which you probably won't notice in the first place, but if you do, you'll absently think that your neighbor has installed a satellite TV dish on his roof and forget about it. Oh, maybe once in a while you might notice it, but you still won't give it any real thought, other than being jealous if you don't have satellite TV.

So one day, a week later, when you have stopped noticing it, it happens to come loose, and instead of pointing at Telstar, it now points at your living room window. But you don't notice . . .

A noise generator placed on the window sill makes it difficult for a listener to hear anything. Edmund Scientific has a sound generator that produces the sounds of rain, a waterfall, and surf, which is random sound and hard to tune out with an equalizer. It is pleasant to listen to (except by the spy across the street) and not distracting like radio or (ugh) TV.

Look for surveillance vans. Is there always a van parked near you? Or a panel truck or pickup with a camper? An amateur probably won't have more than one, but the feds have many and will probably switch them frequently. Perhaps you can find out who it is.

Do a little spying yourself. Write down license numbers and see if the same ones (but not necessarily on the same vehicles) are there at different times. If you see a van pull up and stop, watch it for a while. If the driver doesn't get out and go somewhere, then someone is probably watching someone. Use binoculars to watch them, but don't let them see you. See if they seem to be there in shifts.

Two pieces of advice: if it is a government surveillance, don't assume that you are the target; by now, you should have a good idea whether you are of any interest to any agency. Second, don't interfere. Interfering can get you into something you can't handle. There might be a drug bust coming down, and you could mess it up. This could end up in a drug dealer not being arrested, or it could result in someone getting hurt—maybe you. Stay out of it.

One way that you might find out who it is is to use a scanner. If you have the frequencies of the police and federal agencies, set it on the repeater input frequencies. You can only hear their radios if they are close. On UHF bands, the mobile units are almost always 5 mc. above the repeater output. If you live in a large city, try this on the local police band, which is probably from 460.050 to 460.550. Set it to search from 465.050 to 564.550. You can hear the signals direct from the police vehicles, not through the repeater, so they come in strong only if they are fairly close.

The frequencies used by both federal and local law enforcement in California, including many of the repeater input frequencies, are given in the book *Government Radio Systems* by Bob Kelty, available at Quement Electronics, or write Kelty at Mobile Radio Resources, 2661 Carol Drive, San Jose, CA 95125 for prices. It's available in book form and on computer disk. Other books have listings for other states.

WARNING: the Electronic Communications Privacy Act places some restrictions on listening. It seems to say that it is unlawful to listen to scrambled conversations, such as the DES used by the FBI and other federal agencies—even though you can't tell what they are saying. Possibly the reason is that they don't want anyone to tape-record them and keep them for decoding. But this is not going to happen with a 72-bit key.

Read it and see if you can decipher it (I can't) before you do this. Or see if you can find a lawyer who is familiar with this federal law.

If you can eliminate law enforcement as the spies, then there may well be something unlawful going on, and maybe you can do something about it. Just be sure you know what you are getting into.

These methods will make your home and office secure from spies. Now let's have a look at surveillance from the other perspective.

PART IX

OBTAINING SURVEILLANCE EQUIPMENT

Before you do any kind of surveillance, keep in mind three things. First, bugging a person for malicious or selfish reasons or to get even is morally wrong. Second, it is against the law. Third, it can get you threatened, beaten up, or shot—which, if you don't already know, isn't the most pleasant way to spend your time. Getting shot at tends not only to ruin one's day, but to make one consider backing off from such situations.

A number of devices that can be used for surveillance are available to anyone who has the money, and many can be homemade. Here are some devices people have used to bug others.

- *Wireless microphones and bugs.* Most of the wireless microphones and bugs that are available from stores and by mail order transmit on the FM broadcast band. The reason is that it is legal to use them as long as you're not listening to someone who does not know about it. The Federal Communications Commission (FCC) permits "low-power" devices to work in these areas, and, of course, almost everyone has an FM radio to use for listening to them.

Wireless microphones and other products can be used (legally) on many other frequencies, but they are less common because not everyone has a scanner that will receive them. But spies do. Some of the frequencies for these are listed in Appendix D.

- *Hearing aids.* Aids for the hearing impaired can be used as bugs. In a classroom or lecture hall, the transmitter is placed on the instructor's desk, and the receiver is used like a hearing aid. The range is often limited to a few hundred feet.
- *Baby monitors.* Some wireless baby monitors use an RF transmitter instead of the subcarrier method. Using a portable scanner, I have received them clearly three blocks from the source. I thought I was doing the users a favor when I called to tell them that their baby monitor was broadcasting their conversations around the neighborhood. They were anything but thankful, but they did stop using it.
- *Citizens band radios.* CB radios have been used as bugs. It is not difficult to take them apart and remove the receiver and case, and they can be small enough to hide in a number of places. Install a different crystal, and it transmits on a frequency that CB receivers and many scanners won't pick up. The same can be done with cordless phones.
- *Two-way radios.* Tyco makes a small two-way radio as part of its Spy-Tech toy line that can be used as a bug.
- *Transmitters used at fast-food drive-up windows.* This can also be used as a secret listening device.

A spy can modify and use any of these, or he can build bugs himself. Some libraries still have books with schematic diagrams of various types of bugs that can be built and used with a little knowledge and experience. Look in the card catalogue under "eavesdropping." The university libraries are a better place to look because such books are usually stolen from public libraries.

Schematic diagrams and other information needed to build a low-frequency transmitter can also be found in back issues of *Popular Electronics*, *Radio Electronics*, and other magazines.

Building them from just a diagram requires the ability to lay out the components and make and drill the circuit board, or perf board, but a number of kits are available that make them easier to build. Usually kits have a circuit board that is predrilled and a pictorial diagram that shows where to place the various parts. The only skills required are the ability to identify the components and to use a soldering iron, and no expensive test equipment is needed.

WHERE TO BUY SURVEILLANCE EQUIPMENT

Rainbow Kits has a wireless microphone kit that works both on and outside the FM band for $12.95 and a line-powered phone transmitter for $10.95.

Another bug, a little more advanced, can be made from the Motorola MC-2831A and MC-2833 chips. They are FM transmitters made for cordless phones. Add a few components and you have a complete bug. The chips sell for less than a dollar and the other parts for about $10.

A different crystal can be used to make it transmit on a frequency in the TV channel 2 band, near the sound portion of the signal. The characteristics of the TV signal make it much more difficult to find, and it can be missed by some bug detectors, unless they are being used by experienced operators. This is the snuggling method mentioned earlier.

Crystals are available from Jameco Electronics and some surplus stores. Check *Nuts and Volts* magazine listings.

These chips can also work in the low- and medium-frequency bands. MF has an area from 1.61 to 1.705 mc. where low-power devices are legal to operate, or with a different crystal it can transmit below the AM broadcast band, where some bug detectors will not find them.

The 2833 chip has an extra unused transistor, and by adding a few more components, it is possible to increase the power output to about 250 milliwatts which, with a decent antenna, should transmit for at least several blocks.

The microphone can be from a hearing aid. Some dealers have older or broken hearing aids that they will sell for a few dollars or give away. The hearing aids also contain other useful parts.

Read a few books on basic electronics, schematic diagrams, and identifying components (resistors, transistors, etc.). Practice with the Rainbow kits, and you may be able to build a bug from the Motorola chips.

For less than $30, you have a sophisticated bug that would cost hundreds of dollars from a "dealer" (if you could find one). If you want to have a technician make something for you, consider calling a community college or other school and hiring a second year work-study electronics student.

To listen to such bugs, it is not necessary to spend $425 on a new scanner. Pawn shops frequently have used scanners and shortwave receivers for less than $100.

Nuts and Volts magazine also has ads for used receivers and a list of electronic flea markets that have used equipment.

If you want something better, go to a dealer that specializes in communications equipment. He should have a wide variety to choose from and professional salespeople who know their business to help you find the right model.

In California, try Quement Electronics in San José or Scanners Unlimited in San Carlos; EEB in the Washington, D.C., area is one of the largest, and Scanner World has a large selection and a free catalogue. Others are listed in Appendix C.

USING SURVEILLANCE DEVICES

If someone decided to bug you, how would he go about doing it? Obtaining a bug is one thing; using it is another. Once he has one, where is he going to hide it? How easily can he access your office or home? How much time will he have? Does he have a way to get in to have a look first? What does he know about you?

Knowing where the most useful information is going to come from makes a difference in where the microphone should be placed. The acoustics of the room should be considered, if possible, as this can affect the quality of the sound it transmits.

Placing a bug behind a picture in a room with otherwise bare walls makes for sound that can be more difficult to understand because of the echoes it picks up, but it can be installed quickly.

The best results are from a microphone that is very close to where the speaker will be. On a desk is an excellent location, such as in a penholder or desk organizer, but if long range is needed or the bug needs to function for a long period of time, then either more space (for batteries) or access to the power line is needed.

If it is to be placed inside a lamp, the one closest to a couch, easy chair, or desk will probably get the best audio, but if the lamp is to contain the modulator described above, it has to be somewhere that light can be seen from outside.

An experienced spy will consider all these things.

The section on physical searching provided much information on where someone might hide a bug. Here are a few more examples.

For short-term surveillance, a disposable bug can be tossed into a wastebasket. You are an attorney and an important client has an appointment with you. The opposition finds out, and it has someone drop in and ask to see you for "only a minute on a very important matter" just before that appointment. The visitor makes up a story or discovers that he made a mistake and has the wrong attorney. He leaves, and you are puzzled or irritated—and also bugged. Meanwhile, another client is in the waiting room listening to you.

Inside a hollowed-out book is another good place, as mentioned earlier. Such books are available at places like the Spy Factory. A small hole is punched in the spine to let the sound in, and the microphone is glued against the hole.

Consider which book to use. Old novels, once read, are more likely to be left on the shelf than reference books. A lawyer who bugs a lawyer or an architect who bugs an architect will have a good idea of which books are likely to be found but seldom used. Switching books and dust jackets take but a few seconds.

Some mattresses have little air vents covered with wire mesh—perfect for letting sound in. A small incision can be made in the fabric and the bug slipped inside and secured with glue, Velcro, or some other adhesive, making sure the microphone is facing the vent. A small piece of the material can be removed from a corner of the mattress or from under the "do not remove" tag that most people do not remove and glued over the opening. It is unlikely to be noticed.

Small two-sided makeup mirrors with metal frames can hide bugs. There is enough space between the mirrors, the small hole where the frame is joined lets sound in, and the wire base makes a decent antenna.

Many stereo speakers have thick foam front panels that are held in place with Velcro. A small piece of the foam can be cut out with a sharp knife and the bug hidden there, which is one of the best places for a bug—except, of course, when the stereo is on. The foam lets all the sound through, is at the right level to hear voices, and can be installed in a minute.

Some speakers sit on small stands, and a bug can be hidden on the bottom of the enclosure with Scotch-mount adhesive. It probably won't be noticed until spring cleaning.

I once heard about a bug that was built into a false bottom of a wastebasket. Only 1/2-inch deep, which no one would notice, the false bottom contained a homemade transmitter with a series of calculator batteries and had four holes in the edge to let the sound in.

Periodically when the batteries got low, the janitor in a large office building was told to switch it with another one and take the bugged one to an office on a different floor and leave it. Later, he was told to switch them again. This went on for years, so the story goes. It's probably true. When is the last time you paid any attention to a wastebasket?

Probably the most clever method of hiding a bug that I know of was one that was built into a large black candle. Part of the inside was carefully melted out from the bottom and the bug (a modified FM wireless microphone with a one-stage transistor amplifier) and two D-cell batteries were placed inside. The antenna was a piece of coat hanger, cut to the precise wavelength for better transmission, heated over a gas stove, and inserted partway into the candle. Then the wax was replaced. A ribbon was placed around it (to hide the microphone and let the sound in) and then warmed at the edges so it stuck to the wax and wouldn't fall off.

The most unusual place for a bug to be hidden that I ever heard is from a story told by a former federal agent, who swears it really happened. For a long time, certain people had been trying to bug someone without success. He was too careful to say anything incriminating anywhere someone could be listening. So what these people did was have one of their female personnel get close to him, and after a while, he began to trust her a little. Then, when they thought he was about to reveal something they wanted to know, she arranged to meet him on a topless beach in California.

Now, there isn't any way to hide a bug on a girl wearing a topless string bikini, right? Wrong. The antenna was hidden inside the strings, and the rest of the bug was . . . internal. Imagination is the only limit to where a bug can be hidden.

THE LISTENING POST

Someone has managed to install a bug in your office. Now where is he going to set up a listening post? This has a lot to do with the type of device selected.

If the listener has an office or apartment next to or directly above or below you, a small wireless microphone will probably work fine. If his listening post is across the street, a high-quality wireless microphone or infrared device is more effective for the job.

A temporary post can be in the phone distribution closet or the maintenance area if the spy has regular access to the area, can use a tape recorder, and can replace the tapes as they become full.

A converted cordless phone will transmit at least a block with a good antenna (such as a curtain rod), so if the listener is that close, he can use one of these.

A van equipped with the necessities (refrigerator, chemical toilet, and communication equipment) is the perfect listening post, as it can be within easy listening range of the target—assuming the spy can find a parking place.

If there is a park near the target, an eavesdropper may buy some thrift-store clothes and become homeless for a while. A pocket-size tape recorder will capture the conversation.

If the feds have set up a post, it will probably be large; an office or apartment rented on a temporary basis. There will likely be six agents assigned to it—three teams of two—and three tape recorders, the large open-reel type, which requires a fair amount of space.

If a repeater system is used, the listening post will be a long distance away. They are too expensive for short transmission. A series phone tap has a low output, so the listening post will be in a neighbor's house or adjacent apartment but not much further.

Use what you can come up with in the profile of the probable spies, estimate the probable distance the bug can transmit (based on information from earlier chapters), and look inside this area. Are there business rivals or other known enemies within the range?

PART X

USING INTERCEPTED INFORMATION

The whole purpose of surveillance is to obtain useful information. Sometimes a listening device produces information that doesn't seem worth anything at the time, but it might become very useful.

An experienced spy tape-records everything he hears and keeps every scrap of information he obtains from any source. He will label, date, and store it for cross-referencing. It is all part of the picture the spy is trying to create. This is one of the "secrets" of intelligence. (The other is that there are no secrets.)

An experienced spy is also careful about how he uses what he hears. If someone suspects he is being listened to, he can draw him out. If one contractor consistently underbids another by a very small amount, someone is going to get suspicious—and maybe get even.

In a lawsuit, if one party always seems to be one step ahead of the other, the latter may suspect surveillance and take appropriate action.

He admitted at the deposition that he had been digging through their trash for several months. He produced a box of scraps of paper he had found. The scraps didn't contain all the information he had amassed, but they didn't check it that thoroughly and didn't know that. If they had, they would have known that he had to have another source of information. He had joined the religious organization pretending to have an interest in their perverse philosophy. His real interest was researching the organization for a book and to find out what had happened to a friend who had joined them. He bugged their offices, and this was the source they never realized he had.

Some victims of surveillance simply destroy any devices they find. Some call in the feds. Others have their own way of dealing with spies. In the above example, someone (an amateur) wasn't as careful as he might have been. There were times when he "knew too much," and it almost cost him his life. To stop his research, someone shot at him and threatened him in other ways.

SURVEILLANCE AND PRIVACY IN THE FUTURE

The latest development in making electronic devices smaller is called direct mount. An integrated circuit, or chip, is actually only about 1/32-inch square, which is too small to connect wires to. To make it easier to use, it is placed inside a plastic or ceramic package with two rows of pins that easily fit onto a printed circuit board. This is called the dual inline package, or DIP. The new direct-mount technology places the chip directly on the printed circuit board, which eliminates the need for the bulky package.

Through the use of direct-mount technology, the burst transmitter can be made as small as a postage stamp and can store sound for an hour or more.

Another new development is the molded-plastic circuit board that can be made in any shape, such as a wall outlet, to hide the burst transmitter. It sends its signal through the air like any RF bug or through the power lines and is almost impossible to find. Mass-produced by companies like Intel and Motorola, these boards are very affordable.

Microminiature bugs the size of an aspirin tablet are powered by a beam of microwave energy and so require no battery. They transmit a hundred feet or so and can be used alone or with a repeater.

Microwave beams penetrate walls and closed windows and are reflected off the air inside a target room to reveal everything spoken there to the listener a mile away. Only a very expensive receiver or spectrum analyzer will detect them.

Computer-enhanced techniques used to reconstruct and enhance video images from space probes have been adapted to improve the sound received from improved lasers and other audio listening devices.

Supersensitive receivers with high-gain directional antennas pick up the radiation from TEMPEST secure computers allowing the user to intercept and store anything on the screen.

Supersophisticated debugging equipment will be invented to find the new surveillance devices, which will again be improved, and better debugging gear will follow, and the game goes on . . .

• • •

In 1952, President Harry Truman created, by way of a supersecret memorandum, the National Security Agency, which for many years the government denied even existed. The present administration could as easily create another supersecret agency for the purpose of domestic spying. This could be done because drug-related crime is a "clear and present danger to the structure and existence of the government," and the agency would not be subject to the Omnibus Act or other laws against electronic surveillance. Neither the people nor the Congress would know about it.

MAYBE THEY ALREADY HAVE . . .

Quis custodiet ipsos custodes?

APPENDIX A

THE STORY OF A BUGGING

About ten years ago, an employee of a medium-size manufacturing company in the Pacific Northwest began working on a plan to burglarize his employer. He planned to steal information about the company's manufacturing methods and other proprietary and technical data. He admitted this when he was confronted by company officials. All of the details of this plot are not available, but some of them are as follows.

The factory was in a secluded location, dark and deserted at night. Security guards made rounds of the area, and the police drove through periodically, but there were long periods of time when no one was there. This made it an easier target.

Photograph one shows the general location of the plant. The factory is at the left center, seen over the guard rail. The company did not want a closer picture that would identify it to be published. This is typical and illustrates a point: most people who have been bugged don't want anyone to know about it. Would you? Because of this, the vast majority of buggings are never publicized and the public has no idea how common it is.

Photograph 2 shows the front of the apartment building in which a company supervisor lived at the time of the bugging.

Photograph 3 shows the window on the left where the microphone was hidden. The bushes completely cover the corner of the building.

Photograph 4 was taken inside the apartment. The wood frame window was broken. The owner of the building kept promising to fix it, but like many landlords, he was too stingy to spend the money if he could avoid it. It was spring, the weather was warm, and so the supervisor did not complain often enough to force the owner to take care of it.

At the top of photograph 5 are wires that were once used to power a light fixture, which was broken and had been taken down. The wires were still hot and were used to power the bug.

Thin speaker wire led around the corner of the building, hidden in the crack between the top of the back door frame and the stucco wall and then down to the ground. From there it was buried under the loose dirt and leaves to where the bug was hidden behind the rhododendron bush. The bug was a homemade transmitter that operated on 330 mc. with an estimated range of half a mile.

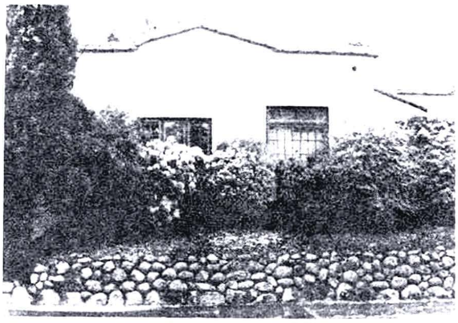
This transmitter could have been powered by a large battery, which could have been hidden easily. Why the bugger used the wiring from the old light fixture is not known, but he could have reached the wires by standing on the railing around the small back porch just a few feet to the left of the broken window without anyone being able to see him because of all the bushes.

How he knew about the broken window and why he believed it would not be fixed soon are also unknown. Possibly, he first intended to use a contact microphone on one of the panes but changed his mind when he discovered the one that wouldn't close. The device wasn't noticed until a storm blew the shrubs away from the wall.

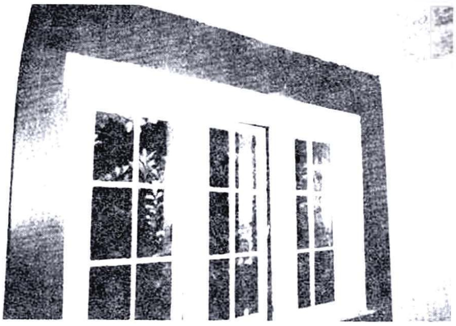
Photograph 6 is another view of the bushes. On the right is a white house. This is where the bugger

Photograph No. 1

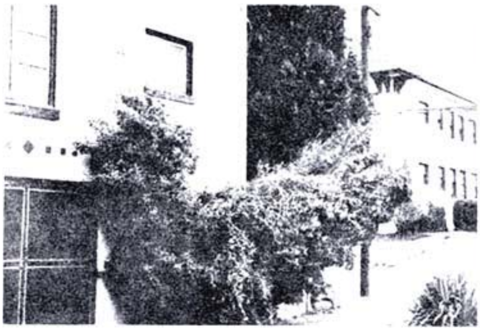
Photograph No. 2



Photograph No. 3



Photograph No. 4



Photograph No. 5

Photograph No. 6

had his listening post. He was a temporary resident of the property. Because he lived too far away from the supervisor's apartment for a bug to transmit, he rented the garage from the people who lived there.

When the supervisor noticed the wire, he followed it and found the transmitter. The supervisor did not know of anyone who would want to bug him and didn't know how long the listening device had been in place since the window had been broken for so long.

He finally concluded that it had something to do with the company and probably was part of a plan to rob or burglarize it, so he reported the incident to the owners. They called a security expert who used a frequency meter to see where the bug was transmitting and advised them to try to draw the bugger out.

Among the mistakes the bugger made were letting people know that he was interested in shortwave radio listening and using the frequency he did. As stated in the section on using a scanner to find bugs, receivers that will tune this area have been widely available for only a few years, and this incident took place in the early eighties.

The countersurveillance plan had the supervisor leak information that the company was going to do something, which they believed would cause the suspected thief to act. The plan worked, and the company employee was caught in the act. He was "dealt with" by the supervisor and some other company employees.

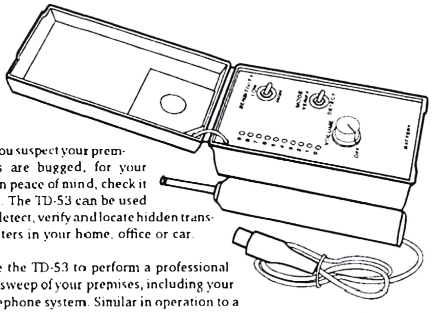
Bugging people can be hazardous to one's health.

APPENDIX B

EQUIPMENT

FROM CAPRI ELECTRONICS

ADVANCED TRANSMITTER (BUG) DETECTOR



If you suspect your premises are bugged, for your own peace of mind, check it out. The TD-53 can be used to detect, verify and locate hidden transmitters in your home, office or car.

Use the TD-53 to perform a professional RF sweep of your premises, including your telephone system. Similar in operation to a Geiger counter, the sensitive antenna system can be used to probe all areas of a room. As the antenna approaches the hidden transmitter, the audible tone clicks faster and faster while the ten step solid-state meter indicates the signal strength.

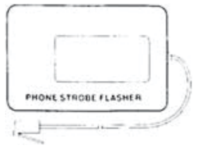
At this point, switch modes from *Detect* to *Verify* to differentiate a bug from a regular radio or TV transmission. If a bugging device is present, a continuous squealing tone is generated by the TD-53. By sweeping the probe, this tone can lead you directly to the bug. The switch selectable *SENSITIVITY* level improves detection capabilities of the unit in high signal strength areas. For private (non-alerting) listening, an earphone jack is provided.

Included with the TD-53 is the P-01 wideband active probe which covers 5 MHz to 1,000 MHz. The P-01 can be positioned up to 25 feet away from the TD-53 by using an extension cable. For example, the probe could be discreetly placed in a target room while the TD-53 is monitored in another room.

Several other plug-in probes are available which will extend the usefulness of your TD-53. (See page 5 of this catalog.)

The unit measures 5.8" x 3.4 x 2" (with cover closed) and weights 9 oz. It is powered by one 9 volt alkaline battery (included). Also included is an illustrated instruction manual.

PHONE STROBE FLASHER



This solid state strobe flashes brightly whenever the phone rings. It is ideal for use in noisy locations to let you know the phone is ringing.

Modular connections for easy installation. Phone line powered - no batteries required. Can be used on single and two line systems, but only line 1 (the red/green pair) will flash.

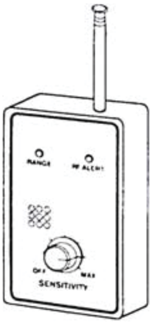
FROM CAPRI ELECTRONICS

ANSWERING MACHINE STOPPER

Eliminate the annoyance of picking up your phone while the message on the answering machine is playing. This device stops the recorded message as soon as any phone in the house is picked up and allows the answering machine to reset itself.

Easy modular connection. Works on single and two line systems. On two line systems, the answering machine must be connected to line 1 (the red/green pair). Only one unit is required and it is plugged in at the answering machine location.

MICROWAVE DETECTOR



As new threats to your privacy are put into use, we develop new products to counter them. The TD-24 is designed to detect the new RF transmitters (bugs) that operate in the low microwave bands.

In use, the TD-24 warns you of the presence of nearby microwave transmitters in the frequency range of 800 MHz to 2500 MHz (2.5 GHz) by the *RF ALERT* LED. The flashing *RANGE* LED and audio tone give an indication of the distance to the bug. (The closer you get to the bug, the faster the LED flashes and the tone clicks.) The *SENSITIVITY* control, along with the two LEDs, helps you quickly zero in on hidden microwave bugs.

A special filter circuit keeps the TD-24 from being activated falsely by signals outside the microwave band. Due to the characteristics of microwaves, three sweeps of the room should be made with the TD-24 antenna adjusted to different lengths as covered in the instructions.

The unit, which weighs 7 oz., measures 4.3" x 2.7" x 1.8". The antenna can be extended to 19" and detaches for easy storage. The TD-24 is furnished with antenna, battery and instruction manual.

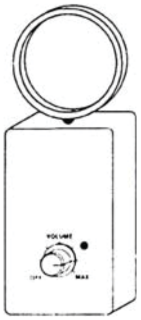
TELEPHONE PRIVACY MODULE

With a TPM-1 on each phone in the house, the first person to pick up the phone is the only one who can use the line until that phone is hung up. No one can listen in on other extensions; thus preventing eavesdropping.

Also useful for preventing interruptions to modem transmissions that can be caused by picking up an extension while the modem is in use. Installs easily with a modular plug on one end and a modular jack on the other end. For single line phones only. Order one for each phone in your house.

FROM CAPRI ELECTRONICS

VIDEO CAMERA DETECTOR



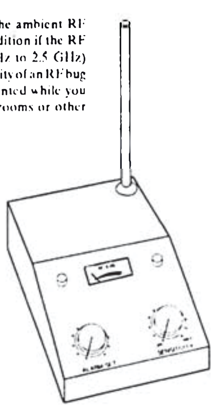
Because video surveillance is becoming more common, you need to be able to detect that type of privacy invasion. The VCD-41 can help you quickly determine if hidden surveillance cameras are being used in any room.

Video cameras radiate a signal which can be picked up by the VCD-41's directional loop antenna and converted to an audible tone. This tone is heard in the earphones (included). The tone increases in volume as you get closer to the camera. By turning the unit with its directional antenna, you can pinpoint the camera's location. Our tests with various cameras have shown a detection range in excess of 12 feet.

The VCD-41 measures 7.5" (with antenna attached) x 2.7" x 1.8", weighs 7 oz. and is furnished complete with 9 volt alkaline battery, earphones and instructions.

RF ROOM GUARD™

Once you set the RF Room Guard for the ambient RF level in a room, it will go to an alarm condition if the RF level in the room (in the range of 1 MHz to 2.5 GHz) increases. This will alert you to the possibility of an RF bug having been carried in by a visitor or planted while you were away. Ideal for use in conference rooms or other areas that need to be secured.



The RF Room Guard can also warn you if your telephone has been bugged with an RF transmitter. If the unit consistantly alarms when you use your telephone, chances are good that an RF bug has been wired in to the phone.

The alarm condition is indicated by a red LED on the front panel. The unit also has an alarm interface that provides both powered (12 VDC) and dry contacts for connecting remote indicators.

The *RF LEVEL* meter gives you a relative reading of the RF signal level in your area. This can also help you determine if an RF bug has been installed nearby.

Controls include *SENSITIVITY* for adjusting for the room's background RF level and *ALARM SET* for adjusting the level at which the alarm will turn on.

An optional Alarm Module gives both an adjustable audible alarm and a flashing visual alarm. It comes with 15 feet of cable. A longer cable can be used if desired. Since it measures only 2.2" x 3.5" x 1.5", it can be placed most anywhere that a remote indicator is desired. The Alarm Module is easily wired to the alarm interface on back of the RF Room Guard.

FROM SHERWOOD COMMUNICATIONS

COMMUNICATIONS INTEGRITY DEVICE

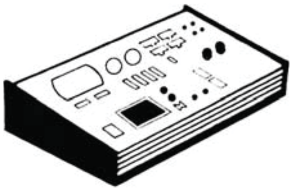
At last a comprehensive instrument and line analyzer for complete telephone security. The Communications Integrity Device (CID-90) was conceived and developed to meet the growing challenges to maintain communications integrity. Designed by TSCM professionals to combat the intrusive threats brought about by rapid developments in communications technology, advanced attacks and other vulnerabilities. The CID-90 uses proprietary LSI circuitry (equivalent to many thousands of transistors) to provide the utmost reliability and flexibility. It is built in a rugged aluminum case, 7" x 12⅞" x 2¾". A sturdy discrete standard locking attache case provides ample room for the unit and all accessories and options. Lightweight unit (only 17 pounds) including accessories.

The CID-90 features the following advances. Any two wires may be accessed for direct testing. An auto ranging panel meter is used to record test results. A 120 Ohm phantom standard load may be placed across any wire pair by a separate control. An Ultra High Gain Audio Amp circuit with filter, facilitates all testing. A separate line driver provides excitation voltage for carbon mics. In addition, the CID-90 contains a polarity reversal control, RF section with a range of 10-750 KHz and a sensitivity of 6 uV. System incorporates line tracers with two types of tones, including silent (ultrasonic), non-alerting supplied with receiver and audio oscillator for conventional testing. Includes comprehensive manual covering standard, electronic and key telephones.

Battery powered for portability by commonly available batteries. A built in battery condition meter assures uninterupted testing. Connections are facilitated by jacks, cords and test clips. Tape recorder output provides for evidence recordings. To enhance the CID-90's capabilities, wire access is provided by an insulated BNC connector, five way binding posts allowing series or parallel access and test ports. These features enable the operator to connect additional equipment used in advanced techniques such as Oscilloscope, Datascope, Vectorscope, Countersurveillance Receivers, Spectrum Analyzers and Time Domain Reflectometers.

The CID-90 detects RF taps, Direct attacks, tape recorder switches, data leakage, instrument manipulation, frame room attacks, system manipulation, system vulnerabilities, audio leakage, duals, constant line monitors, burglar alarms, phantom transmitters, passive by-passes and dialed number recorders.

CID-90 will also perform the following tests: On-Hook/Off Hook-voltage and current, all wire listen, phantom transmitter detection, loop current, balance testing, resistance and capacitance.

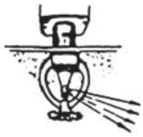


LUNAR LIGHT CAMERAS

Lunar light low night level camera features single stage Image Intensifier and 1" Newvicon (body only, without lens). Extremely high sensitivity operation; useable picture 3 x 10-4 footcandles. Resolution of more than 600 lines at center, low blooming and low image retention; built in RS-170 LSI sync generator, automatic beam control, automatic electronic focus control, automatic gain control. Heavy-duty die-cast construction.

SPRINKLER HEAD SURVEILLANCE

Pinhole lens disguised in a standard pendent fire sprinkler head. The lens has an adjustable iris and head to see in any 360 degree direction. Adjustable downward and to the side by moving a set screw. Two focal lengths available. The 11mm f/2.5 sees a field of view of 10' x 13.5' at 15 feet. The 22mm "sees" 5' x 6.5' at 15 feet. Easy to install. Attaches to all "C" mount cameras. COMPLETE with ceiling mount.



PINHOLE LENSES

Designed for use on concealed cameras, the Pinhole Lenses are useful in any Undercover surveillance work. Compact size and minimal front exposure ensure discreet observation.

No. 5020 Straight Pinhole Lens 9.0mm/F3.4
No. 5021 R.A. Pinhole Lens 9.0mm/F3.4
No. 6000 Straight Pinhole Lens 5.5mm/F3.0
No. 6001 R.A. Pinhole Lens 5.5mm/F3.0
No. 6002 Straight Pinhole Lens 11mm/F2.3
No. 6003 R.A. Pinhole Lens 11mm/F2.3
No. 6004 Camcorder/35mm Lens 8mm/F2.0
No. 6005 Camcorder/35mm Lens 11mm/F2.0
AUTO IRIS ALSO AVAILABLE

MINI-CHIP CAMERA

Miniature CCD chip camera for easy concealment and mounting in tight places. Solid-state design requires no maintenance, estimated camera life is 10 years. 12 VDC or 110 VAC power makes the CCD a natural choice for use in vehicles and applications requiring portability or battery backup. Features C mount lens and auto exposure system. Resolution Vertical 350; Horizontal 400. Sensitivity: Minimum illumination 3 Lux at F/1.4. Power consumption 0.3 Watts. 1.25" x 1.25" x 4.0". Several Models Available.

FROM SHERWOOD COMMUNICATIONS

STEALTH BODY WIRE SYSTEM

As versatile as it is rugged and dependable the Stealth Body Wire System should be your first choice when concealment, plus high performance and reliability are the criteria. The system assures crisp, clear wireless operation, up to one-quarter mile, for listening or recording. Applications include: buys, investigative reporting and protection of undercover officers.

System receiver features automatic remote or manual operation. Six channel capability allows the receiver to monitor six different frequencies with a flip of a switch. A five position audio filter allows the person monitoring to switch various filters in and out in order to reduce background noises. Audio control include volume, squelch, and tone. A signal strength meter allows for visual review of incoming signals. Dedicated monitoring can be conducted with an 1/8 earphone or headphone monitoring with the 1/4 earphone. The sealed, lead acid battery provides long life power. May be recharged with 12VDC or 110 VAC power source. Accessories include receiving crystal, COR receiver-recording cable, 110 VAC charging cable, auto lighter cable, telescoping antenna and sturdy carrying case.

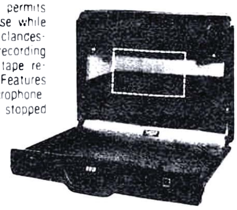
The transmitter operates in the frequency range of 150 to 174 MHz. The transmitter also includes an external microphone jack. Audio AGC with on/off switch helps to maintain constant deviation and noise level. Rechargeable NiCad battery provides 100 mW RF power output for approximately two hours when fully charged. Ruggedly constructed and completely self-contained in heavy guage aluminum.

STEALTH SYSTEM OPTIONS

Additional options enhance the overall system performance of the Stealth System.

ATTACHE CASE RECORDING SYSTEM

Superb recording briefcase permits the full use of the briefcase while simultaneously providing clandestine and surreptitious recording capabilities. Choose your tape recorder from our stock. Features supersensitive hidden microphone. The recorder is started and stopped externally.



No. 4041 Attache Case Recorder (Leather)
No. 4042 Attache Case Recorder (Samsonite)

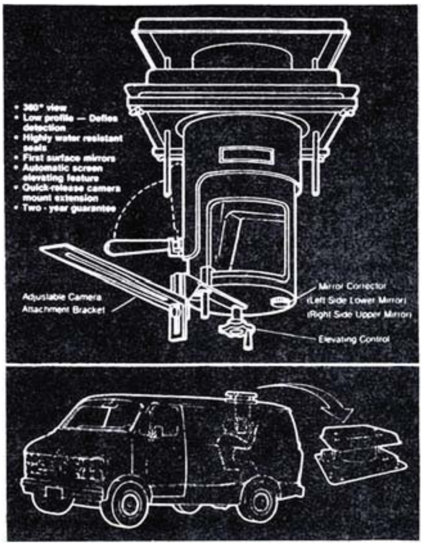
SPECIAL OPERATIONS RECORDER

Specially modified portable cassette recorder recorder for special operations. Easy to use voice actuation prevents silent gaps to save you tape and time. Features regular and half speed to double the recording time. 1 7/8 and 15/16th IPS. Cue/review finds selections with ease. Includes auto-level for perfect volume playback, tape counter, mike switch and mic jack for powering electret mics. Remote jack has zero current drain to preserve battery on telephone installations.

No. 5035 Special Operations Recorder
No. 2501 D-120 Tape
No. 9003 AC Power Supply
No. 9001 12 VDC Vehicle Adapter

UNDERCOVER VEHICLE VIDEO SYSTEM

Mounts specialized camera discreetly in trunk of car. Remote control system/monitor, located in the driver's compartment, controls the video cameras rotation, elevation, zoom and focus. All activities are viewed on a 3" screen. The camera's ovjective lens is concealed behind a simulated side marker. The camera's pan and tilt movements occur at the lens' front element, enabling the system to view through small openings yet allowing for a wide range of motion. Supplied with a 12VDC camera, auto iris zoom lens, 6 hour tape deck, output for RF, cables, and installation manual.


• 360° view
• Low profile — Defies detection
• Highly water resistant seals
• First surface mirrors
• Automatic screen elevating feature
• Quick-release camera mount extension
• Two - year guarantee
Adjustable Camera Attachment Bracket
Mirror Corrector (Left Side Lower Mirror) (Right Side Upper Mirror)
Elevating Control

The Van Periscope is designed to look like a standard air vent on a camper or van. It is a perfectly concealed viewing device. The system offers 360 degrees of rotation and 30 degrees of vertical correction, and is undetectable in close situations. The wire concealment screen is retractable, allowing for covert and undetectable viewing.

It is supplied with a universal camera mount which will accomodate still, video, telephoto and night vision applications. All camera and lens combinations of any size can be attached to the extension mount. The camera mount can be installed or removed in seconds.

Effective video can be recorded with the periscope extended only 1 inch above the roof of the surveillance vehicle. A standard 14" x 14" air vent conceals the Van Periscope and makes it undetectable in close surveillance situations.

Other outstanding features of the Van Periscope include the use of first surface mirrors on all optics, highly water resistant seals to protect the system integrity and an automatic screen elevating machanism.

Specifications:

Weight	18 lbs
Viewing Area	360 degrees
Protrusion Above Roof	7
Vertical Correction	30 degrees
Installation: Fits into 14" x 14" air vent opening	

Camera Mount:

Horizontal adjustment	19"
Vertical adjustment	7"
Quick releasing	

CARRIER CURRENT SOUND MONITOR

The smart electronic babysitter - listen from another room. Hear without actually being there! For use in homes, offices and industrial facilities. Just plug it into any AC outlet and monitor all activites. Receiver has volume control.

TIME-TEC

Time-Tec is a self-contained digital clock and an advanced high-tech R.F. detection circuit to detect any radio transmitting bugging devices within the range of 20 MHz to 1 GHz. Operates on AC current and is capable of detection within a 6 foot to 50 foot range. Clock time display blanks out in the presence of a bug leaving only the colon between the hour and minute. When the device is no longer present, the correct time will automatically return to the clock. Features fully functional alarm mode and battery back-up. Includes instructions and test transmitter.

R.F. TRANSMITTER & TAPE RECORDER DETECTOR

Designed to be worn on the body, the pocket size detector features a silent mode vibrator that is totally covert in operation. Instantly alerts you to the presence of a recorder or bug which is identified by the visual LED's located on the panel. Features dual mode wristwand antenna, silent vibrator alert, LED's, test transmitter, low battery indicator and self-contained rechargeable battery pack. Rugged aircraft construction. Test transmitter included.

BUG DETECTOR/LOCATOR

Quietly and accurately detect and locate R.F. bugging devices in telephones, vehicles, boats, rooms, aircraft or concealed on the body. Because of the auto function, the BD/L has successfully detected eavesdropping signals in both strong R.F. signal areas as well as simpler environments by nontechnical personnel. Portable, battery powered unit operates in 1-1000 MHz range. Includes headphones, earphones, test transmitter, battery, vinyl case and instructions.

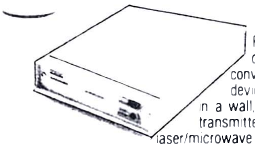
TELEMONITOR 2000

The Telemonitor 2000 utilizes advanced logic-chip technology, enabling you to discreetly listen in on your premises from any tone telephone in the world. Unlike other products, it does not require an activating beeper or whistle. Allows up to four units per line to be attached and is compatible with virtually all telephone exchanges in use in the U.S. Sensitive microphone will pick up whispers at 35 feet. Features an area select knob. Equipped with modular plugs. Requires no batteries. Will not affect normal incoming and outgoing calls even while monitoring.

TELEPHONE WATCHMAN

Remote activation feature allows th user to telephone from virtual anywhere in the world and listen t what is happening at another location. Activated by standard touch tones with unique 4-digit codes Sensitive microphone detects th faintest of sounds ranging fror hushed conversation to a wate faucet left running - all with excellen clarity. Includes a detachable mi Capable of remoting the mic over crophone and detailed instructions 100' distance. 3" x 4" x1"

ACOUSTIC NOISE GENERATOR



For protection against listening devices that are not detectable by conventional methods. Defeats such devices as wired microphones buried in a wall, contact or spike microphones, transmitters located in AC outlets and laser/microwave reflection from windows. Produces noise that completely covers your private conversations with unfilterable sound. Includes one transducer and various connectors for coupling walls, ceilings or air ducts. Capable of driving up to four transducers. 1.7" x 6.0" x 10.0" 3 LB.

ULTRAVIOLET INSPECTION LIGHT

This compact long wave ultraviole lamp is the smallest in the world. The lamp measures only 6¼ inches long by 2⅛ inches wide and is only ¾ inches thick. This 4 watt ultraviolet lamp operates on four (4) AA alkaline batteries, which are easily replaced. Rugged, thermoplastic lamp housing guarantees years of dependable service. Ideal for thief detection purposes, re-admission control and a must for TSCM inspections.

NVEC-500 POCKETSCOPE

The NVEC 500 second generation viewer is one of the smallest, lightest and highest performance hand held night vision instruments currently available. It utilizes a 18mm second generation, MCP wafer type image intensifier. This tube provides self-limiting brightness which eliminates blooming and streaking whenever bright objects are in the field of view.

The NVEC 500 is supplied with a 2 X 50mm objective lens and can be coupled to any C mount lens. This allows various optical configurations using low cost standard 'C' mount lenses. The eyepiece is adjustable to compensate for any visual requirement.

This extremely compact unit is available with factory new, or reconditioned selected grade intensifiers for significant optical cost savings. Shipped with carrying case, battery, and operating instructions.

SPECIFICATIONS

OPTICAL

Magnification	1X, 2X or 3X
Diopter Range	+3 to -4

IMAGE TUBE

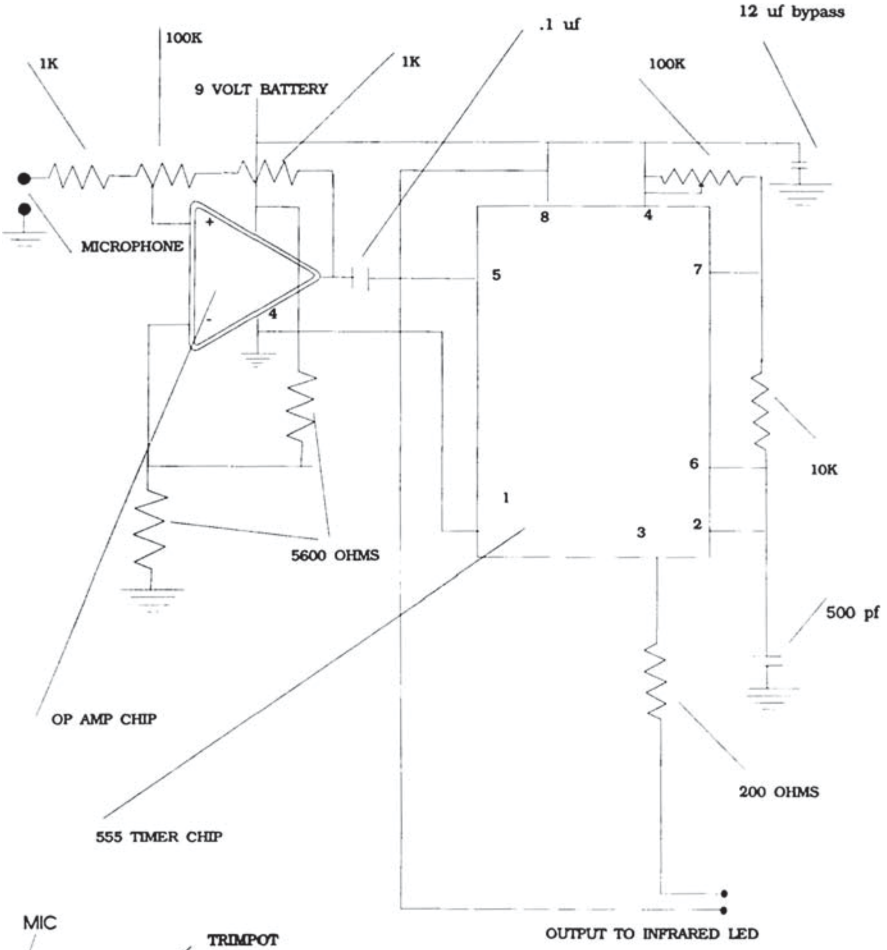
Type	MX-9916
Resolution	28 Lp/mm
Photocathode	S-20R
Gain	7,000 Min.-15,000 Max

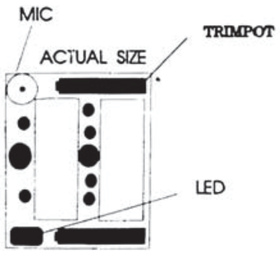
MECHANICAL

Length	5.3 in
Width	2 in
Height	3 in
Weight	10 oz

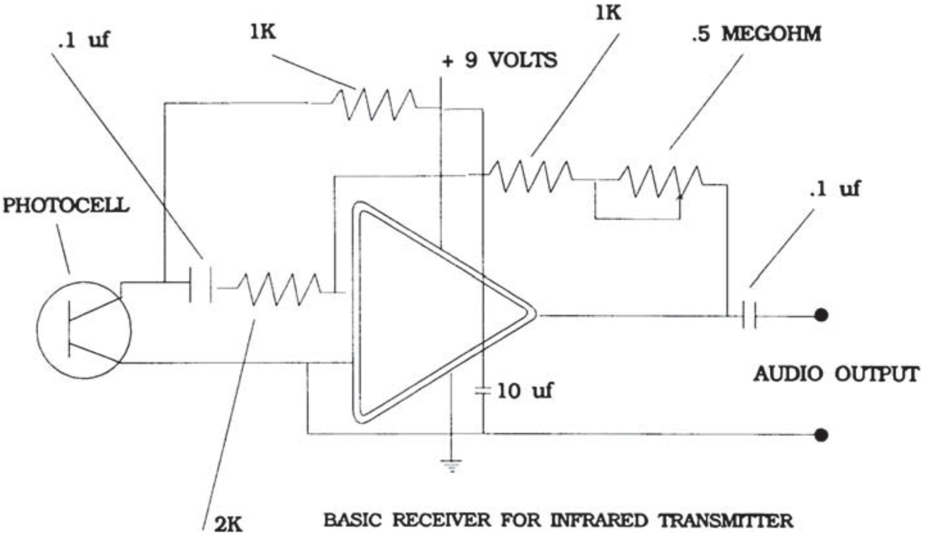
ELECTRICAL

Power	3 VDC
Battery	2 "AA"
Battery Life	25 - 30 Hrs

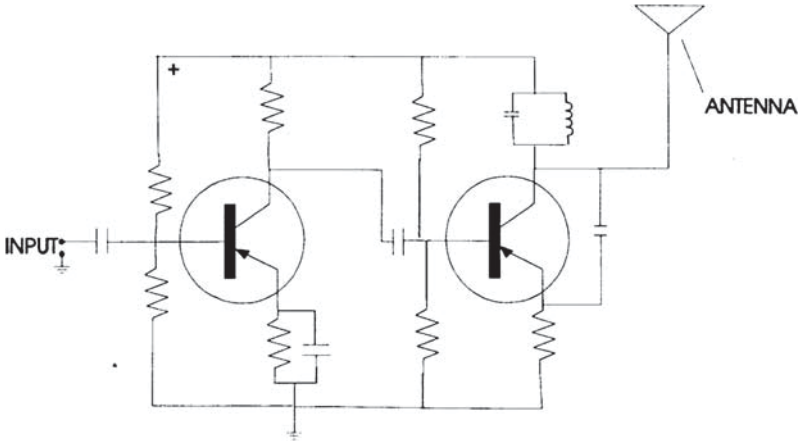




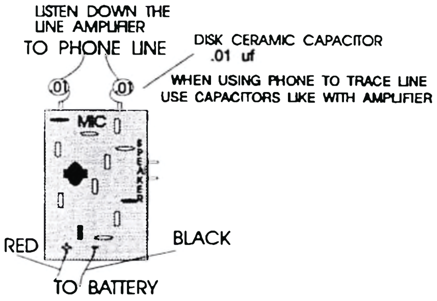
SCHEMATIC DIAGRAM OF
INFRARED TRANSMITTER

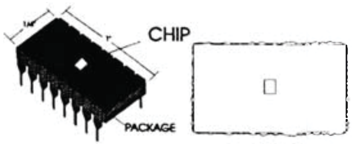


BASIC RECEIVER FOR INFRARED TRANSMITTER

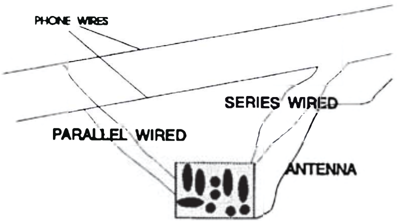


GENERIC SCHEMATIC OF A
WIRELESS MICROPHONE
IT HAS ONLY 14 PARTS

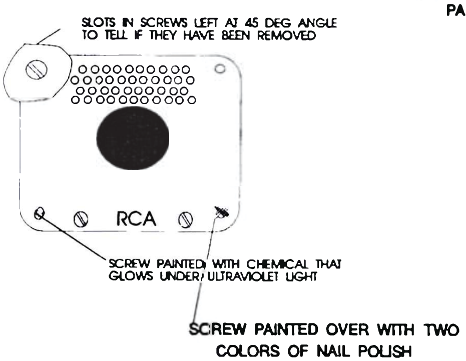


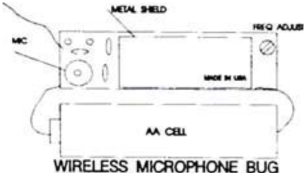


USING DIRECT MOUNT TECHNOLOGY
DOZENS OF INTEGRATED CIRCUITS
FIT IN THE SPACE OF A STAMP

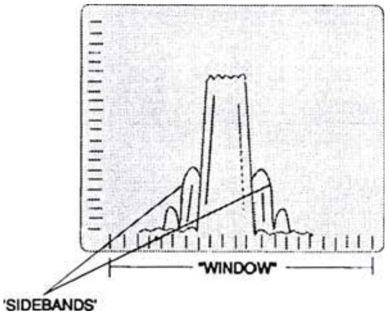


A PHONE BUG CAN BE
AS SMALL AS A PEA


SLOTS IN SCREWS LEFT AT 45 DEG ANGLE
TO TELL IF THEY HAVE BEEN REMOVED
RCA
SCREW PAINTED WITH CHEMICAL THAT
GLOWS UNDER ULTRAVIOLET LIGHT
SCREW PAINTED OVER WITH TWO
COLORS OF NAIL POLISH



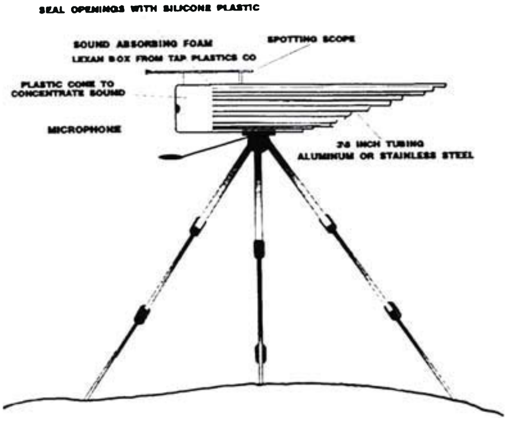
WIRELESS MICROPHONE BUG
(ACTUAL SIZE)



'BLIP' ON SCREEN OF A
SPECTRUM ANALYZER

SHAPE SHOWS MODE; AM,FM...
HEIGHT SHOWS SIGNAL STRENGTH

ORGANIC BUG
(ACTUAL SIZE)


SEAL OPENINGS WITH SILICONE PLASTIC
SOUND ABSORBING FOAM
LEXAN BOX FROM TAP PLASTICS CO
SPOTTING SCOPE
PLASTIC CONE TO CONCENTRATE SOUND
MICROPHONE
3/8 INCH TUBING ALUMINUM OR STAINLESS STEEL

'GATLING' TYPE
SHOTGUN MICROPHONE

OPTOELECTRONICS

R10 COMMUNICATIONS TEST RECEIVER

Introductory Price $299

The *NEW* OPTOELECTRONICS R10 is a self contained FM modulation monitor that will lock on and demodulate signals from nearby transmitters. It can be used to check the modulation quality of most land mobile transmitters and with the use of a frequency counter can be used to verify many signalling tones including CTCSS and DTMF. The R10 is easy to use and provides a fast, inexpensive alternative to service monitors to verify transmitter modulation.

OPTIONS

NiCad 90
Rechargeable NiCad Battery $75

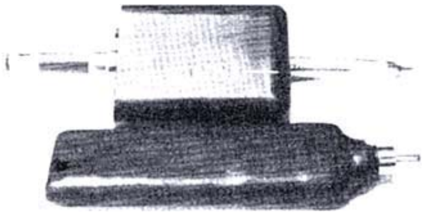
TA100
Telescoping Whip Antenna with swivel base for bench/field use $14

Order Today!

Optoelectronics, Inc
5821 Northeast 14th Avenue
Fort Lauderdale, Florida 33334
Toll Free Order Line 1-800-327-5912
In FL 305-771-2050 • FAX 305-771-2052

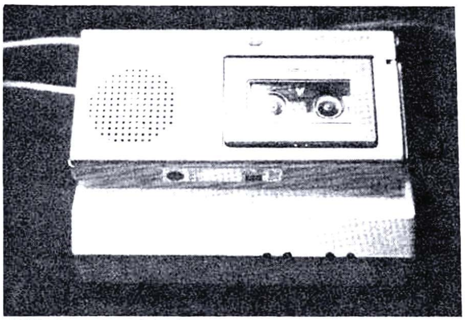
PRELIMINARY SPECIFICATIONS

Frequency Range	30-1000MHz
Demodulation	FM
Deviation Range	up to 50kHz
Frequency Response	50-5000Hz
Auto Tune Time	less than 2 seconds
Input	50Ω, approximately 0 dBm
Outputs	Front panel Speaker, Front panel Audio out
Front Panel Controls	Audio Level, Squelch, Power
Front Panel Indicators	Lock, Power, Low Battery
Power Requirements	9 VDC 200mA
Rear Panel Output	Output for model PC10 (PC based multi function counter) permits high resolution reciprocal measurements and data logging
Compact Aluminum Cabinet	3.5"H x 7.3" W x 6.8" D Textured Polycarbonate/Aluminum laminate front and rear panels

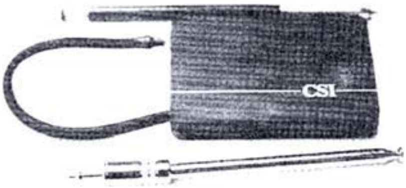


CSI tape-recorder detector.

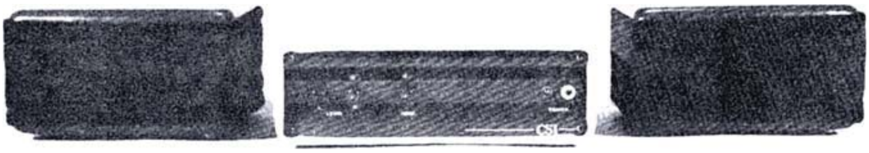
The Hunter from CSI.



CSI phone-tap detector.



The Informer bug detector from CSI.



The "Exterminator" ultrasonic sound microphone jammer.

APPENDIX C

LIST OF SUPPLIERS

The asterisk (*) after some companies indicates that all requests should be sent on a company letterhead. These companies deal only with established businesses or government agencies.

Unless otherwise stated, I believe (or know from personal experience) all of the products listed here to be of good quality, or I wouldn't have included them. I have neither asked for, received, nor been offered any form of compensation from any business in exchange for listing them. I plug 'em as I see 'em.

2600
P.O. Box 752
Middle Island, NY 11953

2600 takes its name from the old 2,600-cycle tone that was used by the original "boxers," such as Captain Crunch, to get free long-distance calls from Ma Bell. 2600 contains interesting information about telco, such as the latest ANI and CNA numbers, and much more. The original phreakers' publication. After all these years, it's still around.

Alpha Industries, Inc.*
651 Lowell Avenue
Methuen, MA 01844

Radio frequency (microwave) surveillance systems built to military specifications.

Amazing Concepts
P.O. Box 716
Amherst, NH 03031

Sells kits for FM transmitters and phone bugs. Also known as Information Unlimited, which has Tesla coil kits and plasma generators and other interesting stuff. Free catalog.

American Laser Systems*
106 Fowler Road
Goleta, CA 93117

Optical surveillance systems built to military specifications.

Antenna Specialists
30500 Bruce Industrial Highway
Cleveland, OH 44139

Antennas, all kinds of antennas.

Bit Connection
719 S. Harbor Boulevard
Fullerton, CA 92632

The Bit Connection has those sometimes hard-to-find TORX bits that open the "security screws" that are on some telco blocks and SPSP connectors. A set of four popular sizes is $12.95, shipped COD.

Buttonware
P.O. Box 5786
Bellevue, WA 98006

Computer shareware.

Capri Electronics Corporation
P.O. Box 589
Bayfield, CO 81122

"Privacy assurance" devices. Equipment for detecting bugs, wireless microphones, and video cameras, among other things. It also has telephone accessories and books. Its TD-53 bug detector has accessory probes for locating the light modulator and infrared bugs and lasers described in the text.

I tested the TD-53. A low-power wireless microphone was hidden inside a retail store while I waited outside (and didn't peek), and I found it in less than a minute. It also has the verify feature. Capri's equipment is moderately priced, and its people are friendly and helpful. I was impressed and recommend Capri.

C&S Sales, Inc.
1245 Rosewood
Deerfield, IL 60015

Test equipment, function generators, and a breadboard minilab for building small electronic projects such as wireless mics with a built-in power supply and wave generators. In kit form, it is $119.95, or $139.95 assembled. Seems like a good deal to me.

CBC International
P.O. Box 31500
Phoenix, AZ 85046

CBC has technical information on modifying CB radios and scanners and building linear amplifiers, and it also carries a large selection of books. Many of its books are very good, but some are a little overpriced. The one on modifying scanners, for example, has a little info on the subject, and the rest is padded with stuff that, while useful, is in some of CBI's other books.

Cony Manufacturing
Room 301, Hirooka Building
#59, 2 Chome
Kangetsu cho
Chikusa-Ku Nagoya 464
JAPAN

Cony manufactures a variety of variable-frequency transmitters and wireless microphones, some of which are sold in spy shops such as the Spy Factory. Depending on whom you ask, they either do or do not export to the United States. I wrote to them eons ago, but I have not yet received a reply.

Consumertronics
2011 Crescent Drive
P.O. Drawer 537
Alamogordo, NM 88310

Consumertronics sells, among other things, plans for building the van Eck computer-eavesdropping system. I sent for them, and for $37 (including UPS, COD), I received a 14-page manual that, for the price, could have been better presented and of better quality. I have not built it, so I do not know if it works or not.

It also has "stealth paints" that will "shield a vehicle from any type of radar detection," "resonant coils that gather high-intensity, harmful electrical noise from the unseen but omnipresent electrosphere and repackage it as pure and precise harmonic energy," and a "laying-on-of-hands amplifier, cerebral synchronizer, and ESP communicator." I have been meaning to buy an ESP communicator for a long time, but I didn't know where to get one.

If these work, then the van Eck circuit probably does also.

Countersurveillance Systems, Inc. (CSI)
1203 Normandy Way
Santa Clara, CA 90500

CSI, located in the heart of smoggy Silicon Valley, makes The Hunter described in the text, bug and tape-recorder detectors, an ultrasonic sound microphone jammer (The Exterminator), and a four-foot parabolic microphone, among other things. Its products are nicely made and professionally packaged, as you can see in Appendix B.

Deco Industries
Box 607
Bedford Hills, NY 10507

Deco has kits for miniature FM transmitters, phone bugs, etc. It has recently contracted with a company that manufactures integrated circuits for a custom-made chip that is the heart of its new wireless microphone kit.

This is the model VT-75, which has a power output of from 75 to 100 milliwatts, depending on the battery voltage, which can be from 6 to 12 volts. Many wireless microphones, some of which cost four times as much, have an output of less than one-fourth as much as the VT-75. It is 9/16 by 1 1/4 inches, and the frequency can be adjusted with a screwdriver, and with a wire antenna only 12 inches long, it has a range of several blocks or more. The VT-75 is in kit form. You have to attach the microphone and antenna wire. Retail price is about $50, and it's the best deal around.

Deco also has a long-play microcassette recorder and several phone bug kits. Write for a free catalog.

Dektor Counter Intelligence & Security*
515 Barnhard Street
Savannah, GA 31401

Offers professional countermeasures services to the private sector, conducts classes and seminars on the subject, and markets a complete line of countermeasures equipment both to the public and law enforcement. Serious inquiries, please.

Eden Press
P.O. Box 8410
Fountain Valley, CA 92728

Eden Press is well-known for its books on privacy and the right to be left alone by government snoops. It has published the classic works on paper tripping and has a wide variety of books on other subjects such as how to hide things, secret agent stuff, financial privacy, offshore banking, Swiss banks, and many nifty ways to make money. Other books are on disguises, revenge, and much, much more. Eden's catalogue is free and highly recommended.

Edmund Scientific, Inc.
101 E. Gloucester Pike
Barrington, NJ 08007

Edmund Scientific is an old established company with a well-deserved reputation for quality products for scientists, students of science, hobbyists, and experimenters. Its colorful 187-page catalogue has a vast selection of fascinating products. It specializes in optics and has page after page of lenses, mirrors, microscopes, lasers, accessories, fiberoptics, borescopes, telescopes, binoculars, filters, infrared and ultraviolet light sources, zillions of magnets, lab equipment and supplies, educational aids and kits, and a whole lot more.This is one of the most fascinating catalogs around.

Electronic Equipment Bank, Inc. (EEB)
516 Mill Street, NE
Vienna, VA 22180

EEB has one of the largest selections of communications receivers and scanners I know of, which includes Sony, Realistic, Japan Radio, Kenwood, Yaesu, Panasonic, Bearcat, Sangean, Drake, and Icom (my favorite).

EEB has the not-so-easy-to-find Fairmate HP200 1,000-channel portable scanner, the AR-3000, which is one helluva scanner even if it isn't made by Icom; a nice selection of books, antennas, and accessories; and the affordable AX-700 spectrum analyzer mentioned in the text.

Electronic Rainbow, Inc.
6254 LaPas Trail
Indianapolis, IN 46268

The Rainbow has kits for building wireless microphones, phone bugs, a high-gain amplifier that can be used with a parabolic microphone, or as a listen-down-the-line amplifier. For $15, Rainbow sells a book with the schematics and circuit board layout, instructions, and parts list for these and ten other kits. This is a good deal, I think.

Electro-Space Systems*
P.O. Box 831359
Richardson, TX 75083

Military optical surveillance systems.

Elenco Electronics
150 W. Carpenter Avenue
Wheeling, IL 60090

Elenco has a nice selection of electronic test equipment, tools, soldering irons, power supplies, function generators, and breadboards for designing electronic things. It also has kits for building wireless microphones and phone bugs and a sound-activated relay, which can have some interesting applications if you think about it.

Everett Enterprises
7855 Wintercress Dr.
Springfield, VA 2f2152

Private-line DES programs for computers.

Excalibur Enterprises
P.O. Box 266
Emmans, PA 18049

Night-vision stuff and starlight scopes for spying on spies.

Full Disclosure
P.O. Box 903
Libertyville, IL 60048

Full Disclosure is a small (volume 23 is 16 pages) newspaper that has up-to-date information on electronic surveillance methods and equipment, interesting articles, and classified ads. The latest issue has articles on fax interception, the alleged FCC attempt to intimidate companies that sell kits and wireless microphones, and some other stuff on what the feds are up to, such as bids to buy surveillance equipment (e.g., the FBI wants to buy Panasonic RN-36 microcassette recorders, and the DEA wants to rent an antenna site from WCIX-TV in Miami). I like this interesting publication. Twelve issues per year for $18.

Grove Enterprises
140 Dog Branch Road
P.O. Box 98
Brasstown, NC 28902

Grove has communications receivers, scanners, and accessories, and it sells the excellent AR-3000 that I keep plugging.

Halted Specialties Co.
3500 Ryder St.
Santa Clara, CA 95051

Halted is a large retail store that has communications receivers and ham equipment, parts and test equipment, computers, and all that, but what is the most interesting is its large selection of used and surplus gear. It also has lasers (usually inexpensive) and other optical goodies that are useful in spying on spies. You can spend hours browsing through the many aisles of stuff.

Heath Company
Benton Harbor, MI 49022

Heath has been around for close to 50 years and has a large line of communications, test equipment and ham gear, and consumer goodies useful in securing your home from spies. It has infrared motion detectors, the Radar Watchdog that detects motion through walls, portable alarms that are activated by opening a door, closed-circuit television cameras, and many other nifty things. Much of its electronic gear is available in the form of kits, and over the years, I have built a number of them. All were of excellent quality and easy to build. I like Heath.

Intelligence Group
1628 Lombard Street
San Francisco, CA 94118

The Intelligence Group is a deceptively small, modernistic store with pretty neon signs and fascinating display cases. In one is a realistic copy of a Smith & Wesson 9mm automatic with attached laser sight (real), a Cobra electronic lockpick that the owner of the store invented, and a collection of authentic police department badges. In another is The Hunter, a spectrum analyzer, the CPM-700 surveillance monitor, and other goodies. It also has scanners, stun guns, and a large selection of books, including Lee Lapin's new one, *Book II, How to Get Anything on Anybody.*

This is what you see in the store. You don't see the closed-circuit cameras that are hidden in some things in which you wouldn't expect to find them, or the complete electronics lab and machine shop in the back, where the company makes its own TV cameras and other equipment. It's not open to the public, though.

IG also does professional countersurveillance sweeps. Stop in when you are in San Francisco. It's just a few blocks west of Van Ness Avenue (U.S. 101).

International Logistics Systems, Inc.*
P.O. Box 25-T
295 Courtlandt Street
Belleville, NJ 07109

This company carries police, security, and executive-protection equipment, including bomb detection and countersurveillance gear. Serious inquiries.

Interphase International, Ltd.*
15650-A Vinyard, Suite 115
Morgan Hill, CA 95037

Interphase is the distributor of the ultrasmall TV camera with the built-in transmitter described in the text. It sells mainly to law-enforcement and security companies, and it doesn't mail catalogs.

Jameco Electronics
1355 Shoreway Road
Belmont, CA 94002

A large and impressive collection of computers, test equipment, parts, tools, cabinets and enclosures, power supplies, cables and connectors, integrated circuits, breadboards and books. Nice color catalogs are free. Stop in if you are in the area.

Litton Applied Technology*
645 Almanor Avenue
Sunnyvale, CA 94088

Military microwave surveillance equipment.

LNR Communications, Inc.*
180 Marcus Boulevard
Hauppauge, NY 11788

Microwave receivers.

Loompanics Unlimited
P.O. Box 1197
Port Townsend, WA 98368

Loompanics describes itself on the front page of its 230-page catalog as "Sellers of Unusual Books." A bit of an understatement, I'd say. Loompanics lists hundreds of books on subjects that you won't find at B. Dalton, such as the underground economy, privacy (your friend and mine), Big Brother, frauds and cons, guerrilla warfare, knives, guns, bombs, anarchy, alternative living, and much more. It also has interesting articles and even cartoons.

If you are interested in just about anything besides working 9 to 5 for someone else and spending the rest of your time being brainwashed by the boob tube, then you will find something useful in the Loompanics catalog. It used to be free, but now it is $3 and is well worth the price. Highly recommended.

Micro-Tel Division*
Adams-Russell Co.
10713 Gilroy Road
Hunt Valley, MD 21030

Microwave surveillance systems.

Microwave Systems, Inc.*
6075 E. Molloy Road
Syracuse, NY 13211

Microwave receivers.

Mobile Radio Resources
1224 Madrona Avenue
San Jose, CA 95125

MRR has two books of interest to scanner enthusiasts. The first is *Government Radio Systems,* which covers California, and put simply, "It's the only book you need."

The local government issue is 448 pages and has the frequencies of virtually every city, county, and state government agency that exists. It goes beyond just lists of numbers, as it includes repeater input frequencies and tone-squelch codes, locations of repeater systems, and channel numbers and how they are assigned. For example, in Los Angeles County there are no fewer than 14 pages devoted to local police, from the Long Beach area to Arcadia, which include primary and secondary channels, links to other departments, detective and narcotics team frequencies, traffic divisions, separate listings for the various precincts in Los Angeles, such as Central, Rampart, Valley, etc. The federal government version is just as complete and lists about every agency in California, including DEA, FBI, Secret Service, INS, Customs, and others. The Secret Service listings, for example, include frequencies assigned to the vice president protection detail, the Night Hawk and Marine One helicopters and Air Force One, White House security, Capitol Police, and more.

The second book is *Military Radio Systems* by Bob Kelty. This one you've got to see. I have known Bob for years and can tell you that there aren't many people who know as much about scanners and radio frequencies as he does.

Nuts and Volts Magazine
P.O. Box 1639
Placentia, CA 92670

Nuts and Volts is a 100-plus-page catalog (April 1991 issue) that has both personal and commercial ads for almost anything that a hobbyist could want. Surplus electronic and test equipment, ham radio gear, parts kits, computer hard- and software, satellite TV decoders, solar cell panels (for powering shotgun microphone amplifiers and other antispy goodies), tools, books, and hard-to-find manuals for old equipment.

It has classified ad sections for information wanted, things for sale or trade, and a calendar of events such as electronic flea markets and the like. *Nuts and Volts* is an excellent source of information. A subscription is $15 per year (12 issues), and a free sample copy is available on request.

Optoelectronics
5821 NE 14th Avenue
Ft. Lauderdale, FL 33334

Optoelectronics makes frequency counters as described in the text. It has various portable models that range from 10 cycles to 2.6 gc. and from $179 to $379, as well as lab-quality bench models. It also makes a circuit board that plugs into a personal computer, which makes it into a frequency counter with the frequency displayed on the monitor screen. It runs under Microsoft Windows 3.0.

Another fascinating product Optoelectronics makes is the R-10, which is a communications test receiver that receives and also demodulates signals from nearby transmitters, such as bugs. The demodulator separates the sound from the signal carrier, which means you can hear what is being transmitted, just as in the verify mode of the TD-53 bug detector. You remember that from the text, right? It covers 30 to 1,000 mc. and presently is 3.5 x 7.3 x 6.8 inches, but the company will soon market it in the same size as its pocket-size counters.

The most interesting product Optoelectronics sells is the model APS204R1 preselector. This little goodie increases the sensitivity of the model 3000 counter pictured in Appendix B so that it picks up a cellular phone from 250 feet away. Fascinating.

Paladin Press
P.O. Box 1307
Boulder, CO 80306

Paladin has a large selection of books on many subjects. It specializes in weapons, self-defense, the martial arts, military science, and survival, and has an impressive selection that includes some interesting titles on knives, such as *The Complete Bladesmith* and *The Master Bladesmith* on making them. Paladin also has titles on getting even, paper tripping, credit, secret hiding places, anarchy, con games, and, of course, electronic surveillance and countersurveillance—including both *How to Get Anything on Anybody* books by Lee Lapin and this book, of course. Its catalog, which is highly recommended, also frequently includes interviews with some of its authors.

PK Elektronik
Heidenkampschweig 74
200 Hamburg 1
Federal Republik of Germany

PK makes both surveillance and countersurveillance gear. The factory is in Germany, but the company has a sales office in New York. (I didn't know that until I called the factory. "Kann ich ein katalog haben, bitte, fur mein book ich bein gerschriben?" I tried to ask before he said, "I speak English.") He told me that the company does not export to private citizens in the United States, only to law-enforcement agencies, the same as the New York sales office. However, it does sell to people who live in Germany (and some other countries), so if sie haben ein freund im Deutschland. He said he would send a catalog, but I haven't received it yet.

Reality Check
(415) 567-7043
1200-2400 BAUD N81

Formerly Just Say Yes, Reality Check is a computer-bulletin board that has current information on what telco is up to. Some of it is quite technical, but some is understandable to beginners. This is a "handle" BBS; it doesn't dig into your personal life or ask a lot of questions to give you access. It is not a pirate BBS, but it has a lot of useful data if you are into telco information.

RSA Data Security, Inc.
10 Twin Dolphin Dr.
Redwood, CA 94065

MailSafe public key program.

Scanners Unlimited
San Carlos, CA

Scanners Unlimited is located a few miles south of San Francisco, and it has a nice selection of scanning radios, which includes Uniden and Realistic, and lots of accessories, books, antennas, etc. I bought my PRO-2006 there.

Scanner World, USA
10 New Scotland Avenue
Albany, NY 12208

Scanner World has been around for as long as scanners have. It has a wide variety of scanners, CB radios, antennas, and accessories. Its catalog is free for the asking.

Sherwood Communications Associates
P.O. Box 535-A
Southampton, PA 18966

Remember the three monkeys, "See no evil, hear no evil, speak no evil"? The first thing I noticed when I got this catalog was the logo, which is a drawing of three heads (human rather than primate). The first has a night-vision device, the second has a microphone, and the third is wearing headphones. I got a kick out of that even though it was probably not designed with levity in mind.

Sherwood is big on video. It has one closed-circuit camera that is the size of a cigarette pack (remember those?) and another that is on an unenclosed printed circuit board using the new surface-mount technology made to conceal inside a smoke detector, complete with wide-angle lens; pinhole lenses that can peek through a tiny hole, and even one that is disguised as a sprinkler head; and a briefcase with camera and VCR inside and small transmitters that send the camera's signal 3,500 feet.

Besides video equipment, Sherwood has directional microphones, telephone accessories (lots of these), tape recorders, two-way radio equipment (including a portable repeater), telephone scramblers, voice-alteration devices, document shredders, night-vision equipment, and the list goes on.

What I find most fascinating is the line of vehicle-surveillance equipment—everything you need to set up a van for spying. The line includes a periscope disguised as an air vent, a swivel chair for 360-degree viewing, camera lenses disguised as reflectors, a silent air conditioner, a bunk bed with storage area, and even a chemical toilet for long-term surveillance.

When I first talked to the people at Sherwood, they said the catalog is "an education in itself." I agree. Sherwood's catalog is 40 pages with lots of illustrations and a nice book list. It costs $10 and is well worth it.

Spy Factory, Inc.
500 Beach Street
San Francisco, CA 94113

Spy Factory is located at Fisherman's Wharf in the Anchorage shopping center. It is one of a chain of eleven stores with the head offices in San Antonio.

It has a variety of interesting products for sale, including several models of bug detectors and other countersurveillance devices, wireless microphones from different manufacturers, invisible marking chemicals that glow under ultraviolet light, stun guns, telephone scramblers, and a large assortment of those clever hiding devices made from the containers of common household products. Just unscrew the top, or maybe the bottom, and stash your goodies inside. A burglar will think they are real because they are.

The salespeople are friendly and willing to demonstrate their products as time permits. Other shops are in Dallas, El Paso, Houston, Tucson, San Diego, Las Vegas, Costa Mesa, West Hollywood, and Sacramento.

Super Software
403 E. Nasa Rd.
Webster, TX 77598

DES computer programs.

SWS Security*
1300 Boyd Road
Street, MD 21154

Electronic surveillance and communications equipment for government and private agencies.

Tucker Surplus Store
1801 Reserve Street
Garland, TX 75355

Tucker's latest catalog is 53 pages, with lots of surplus electronic equipment and reasonable prices. It has meters for measuring phone line resistance and voltage, a reflectometer or two, function generators that—with an antenna and maybe a one-transistor amplifier—will jam a van Eck computer snooper system, and lots of other stuff, including a low-cost spectrum analyzer, just in case you have no budget for the $80,000 Hewlett-Packard model.

Viking International
150 Executive Park Boulevard
San Francisco, CA 94134

Viking has some excellent audio equipment such as long-play tape recorders, specialized microphones and preamplifiers, dropout relays, and "The Firefly," a small battery-powered infrared light source that can be carried around in the field to make it easier to tell the good guys from the bad guys, or the other way around. Its long-play recorders are not the cheapo types that have a resistor connected across the remote-control jack; they have special electronic circuits to compensate for the extended recording time, which improves the audio quality.

ZK Celltest Systems*
137 E. Fremont Avenue
Sunnyvale, CA 94087

ZK makes a pocket-size SAM, which you remember is a cellular radio system access monitor. On its front panel, it displays the numbers from the NAM of a cellular phone from its radio signal and stores them for later printing. ZK is picky about whom it will sell to; it won't sell one to just anyone who wants one.

APPENDIX D

FREQUENCY LIST

The following frequencies are likely to be used for bugs.

CITIZENS BAND CHANNELS 01 TO 40

01: 26.965 mc.
02: 26.975 mc.
03: 26.985 mc.
04: 27.005 mc.
05: 27.015 mc.
06: 27.025 mc.
07: 27.035 mc.
08: 27.055 mc.
09: 27.065 mc.
10: 27.075 mc.
11: 27.085 mc.
12: 27.105 mc.
13: 27.115 mc.
14: 27.125 mc.
15: 27.135 mc.
16: 27.155 mc.
17: 27.165 mc.
18: 27.175 mc.
19: 27.185 mc.
20: 27.205 mc.
21: 27.215 mc.
22: 27.225 mc.
23: 27.235 mc.
24: 27.245 mc.
25: 27.255 mc.
26: 27.265 mc.
27: 27.275 mc.
28: 27.285 mc.
29: 27.295 mc.
30: 27.305 mc.
31: 27.315 mc.
32: 27.325 mc.
33: 27.335 mc.
34: 27.345 mc.
35: 27.355 mc.
36: 27.365 mc.
37: 27.375 mc.
38: 27.385 mc.
39: 27.395 mc.
40: 27.405 mc.

AUDIO FREQUENCIES FOR TV BROADCASTING CHANNELS 02 TO 69

59.75 mc.	TV ch. 2
65.75 mc.	TV ch. 3
71.75 mc.	TV ch. 4
81.75 mc.	TV ch. 5
87.75 mc.	TV ch. 6
179.75 mc.	TV ch. 7
185.75 mc.	TV ch. 8
191.75 mc.	TV ch. 9
197.75 mc.	TV ch. 10
203.75 mc.	TV ch. 11
209.75 mc.	TV ch. 12
215.75 mc.	TV ch. 13
475.75 mc.	TV ch. 14
481.75 mc.	TV ch. 15

In the snuggling method described in the text, a bug will transmit close to one of these frequencies, usually the lower channels 2 to 5. A bug made from the Motorola MC2833 chip works only on channel 2, as its highest effective frequency is 60 mc.

OLD CORDLESS TELEPHONE FREQUENCIES

Base	Mobile
1.705 mc.	49.67 mc.
1.735 mc.	49.845 mc.
1.765 mc.	49.86 mc.
1.795 mc.	49.77 mc.
1.825 mc.	49.875 mc.

NEW CORDLESS TELEPHONE FREQUENCIES

46.61 mc.	49.67 mc.
46.63 mc.	49.845 mc.
46.67 mc.	49.86 mc.
46.71 mc.	49.77 mc.
46.73 mc.	49.875 mc.
46.77 mc.	49.83 mc.
46.83 mc.	49.89 mc.
46.87 mc.	49.93 mc.
46.93 mc.	49.99 mc.
46.97 mc.	49.97 mc.

WIRELESS MICROPHONES

36.70, 37.10, 37.16, 40.68, 42.89, 44.87, 47.27, 169.45, 169.505, 170.245, 170.045, 171.105, 171.845, 171.905

UNKNOWN

Conversations have been reported on the following frequencies.

47.42, 47.46, 47.50, 49.375, 49.39, 49.405, 49.42, 49.435, 49.70, 49.80

FAST-FOOD RESTAURANT DRIVE-UP WINDOWS

McDonald's	35.020	and	154.600
	30.840	and	154.570
	33.140	and	151.895
Burgerville	30.840	and	154.570
?	?	and	157.595
Burger King	467.825	and	457.600
Taco Bell	460.8875		
Hardee's	030.84	and	154.57
?	031.000	and	170.305
?	154.600	and	171.105
?	170.245	and	154.570

WIRELESS BABY MONITORS (use cordless phone frequencies)

49.83 49.845 49.86 49.875 49.89

AUDITORY AIDS FOR HEARING IMPAIRED

72.025 to 72.975 and 75.475 to 75.975

These are a small transmitter/receiver set. The receiver is used like a hearing aid, and the transmitter can be beside a telephone doorbell, the speaker in a lecture hall, etc.

FEDERAL FREQUENCIES

The following frequency areas are listed as being used by undercover federal agents. Since they have been published, they have probably been changed, but one never knows. These are from Bob Kelty's book.

FBI

Mobile Tracking "Bumper Beepers"

40.170 40.220

Wireless Microphones

169.445 169.505 170.245 170.305
171.045 171.105 171.845 171.905

Body Taps or Wires

171.450 171.600 171.750 171.850
172.000 172.2125 172.2375 172.2625
172.2875 172.3125 172.3375 172.3625
172.3875

DEA

418.750 418.675

SECRET SERVICE

407.800 406.275 408.500 408.975

TREASURY DEPARTMENT/BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS

166.2875 170.4125

OPTOELECTRONICS
HANDI-COUNTER
MODEL 3000
146.0096065

APPENDIX E

FREQUENCY ALLOCATION TABLE

029.000-029.800	FOREST PRODUCTS
029.800-029.890	FIXED SERVICE
029.900-029.910	FEDERAL GOVT.
029.920-029.990	FIXED SERVICE
030.000-030.560	FEDERAL GOVT.
030.560-030.660	SPECIAL INDUSTRIAL
030.660-030.820	PETROL-FOREST-TRUCKING
030.840-031.260	BUSINESS TRUCKING FORESTRY
031.280-031.980	FORESTRY CONSERVATION INDUSTRIAL
032.000-033.000	FEDERAL GOVT.
033.020-033.160	HIWAY MAINT. SPEC. EMERG. BUSINESS
033.180-033.380	PETROLEUM RADIO SERVICE
033.380-033.420	BUSINESS
033.420-033.980	FIRE
034.000-035.000	FEDERAL GOVT.
035.020-035.180	BUSINESS
035.160-035.220	TELEPHONE MAINT.
035.220-035.620	MOBILE PHONE PAGING
035.640-035.680	MOBILE PHONE EMERGENCY PAGING
035.700-035.720	BUSINESS
035.740-035.860	SPECIAL INDUSTRIAL
035.880-035.980	BUSINESS
036.000-037.000	FEDERAL GOVT.
037.020-037.420	POLICE LOCAL GOVT.
037.420-037.460	FOREST PRODUCTS
037.460-037.860	POWER COMPANIES
037.860-037.900	FOREST PRODUCTS
037.900-037.980	HIWAY MAINT.
038.000-039.000	FEDERAL GOVT.
039.020-039.980	POLICE LOCAL GOVT.
040.000-042.000	FEDERAL GOVT.
042.020-042.940	STATE POLICE
042.960-043.000	BUSINESS
043.020-043.180	SPECIAL INDUSTRIAL
043.180-043.220	TELEPHONE MAINT.
043.220-043.620	MOBILE PHONE PAGING INDUSTRIAL
043.640-043.680	MOBILE PHONE EMERGENCY PAGING
043.700-044.600	TRUCKING
044.620-045.040	POLICE FORESTRY
045.060-045.640	POLICE LOCAL GOVT.
045.660-045.860	POLICE HIWAY MAINT.
045.880-045.890	FIRE INTERSYSTEM NET
045.900-046.040	POLICE SPECIAL EMERG.
046.040-046.500	FIRE
046.520-046.580	LOCAL GOVT.
046.600-047.000	FEDERAL GOVT.
047.020-047.400	HIWAY MAINT.
047.420-047.680	SPECIAL EMERG., INDUSTRIAL
047.700-048.540	POWER COMPANIES
048.560-049.500	FOREST PRODUCTS, PETROL
049.520-049.580	FOREST PRODUCTS, PETROL
049.600-050.000	FEDERAL GOVT.
050.000-054.000	HAM SIX METERS
054.000-072.000	TV CHANNELS 2, 3, 4
072.000-076.000	FIXED, PORTABLE
076.000-088.000	TV CHANNELS 5, 6
088.000-108.000	FM BROADCASTING
108.000-117.950	AERO, NAVIGATION
118.000-128.800	AERO, AIR-TRAFFIC CONTROL

128.825-132.000	AERO, AIRLINE FREQUENCIES
132.000-136.000	AERO, AIR-TRAFFIC CONTROL
136.000-144.000	FEDERAL GOVT.
144.000-148.000	HAM TWO METERS
148.000-150.800	FEDERAL GOVT.
150.815-150.965	AUTO CLUBS, TOW TRUCKS
150.965-150.995	PETROL, OIL SPILL CLEAN-UP
150.995-151.130	HIWAY MAINT.
151.145-151.490	FORESTRY CONSERVATION
151.490-151.595	SPECIAL INDUSTRIAL
151.625-151.955	BUSINESS
151.985-152.065	TELEPHONE MAINT.
152.075-152.125	EMERGENCY PAGING
152.130-152.240	RCC
152.270-152.480	TAXI BUSINESS
152.510-152.810	MOBILE PHONE
152.840-152.860	PAGING
152.870-153.035	REMOTE BROADCAST, MOVIE COMPANIES
153.035-153.395	REMOTE PICKUP FOREST PRODUCTS
153.410-153.725	POWER COMPANIES
153.740-154.115	FIRE, LOCAL GOVT.
153.130-154.445	FIRE
154.460-154.490	LOCAL GOVT. POWER SPECIAL INDUSTRIAL
154.515-154.575	BUSINESS FOREST PRODUCTS
154.585-154-640	PETROL, OIL SPILL CLEAN-UP
154.650-154.950	POLICE (USUALLY COUNTY AND STATE)
154.965-155.145	POLICE LOCAL GOVT.
155.160-155.400	POLICE, SPECIAL EMERGENCY
155.415-155.700	POLICE
155.715-156.030	POLICE, LOCAL GOVT.
156.045-156.240	HIWAY MAINT., POLICE
156.275-157.425	MARINE
157.425-157.470	PAGING
157.450	EMERGENCY PAGING
157.470-157.515	AUTO EMERG. SERV., AUTO CLUBS, TOWING
157.530-157.710	TAXI
157.740-157.760	PAGING
157.770-158.070	MOBILE PHONE (MOBILE UNITS)
158.200	PAGING
158.130-158.265	POWER, PETROL
158.280-158.460	PETROL, FOREST
158.490-158.670	RCC MOBILE UNITS
158.700	PAGING
158.730-158.970	POLICE, LOCAL GOVT.
158.985-159.195	POLICE, HIWAY MAINT.
159.225-159.465	FOREST CONSERVATION
159.470-157.490	PETROL OILSPILL CLEAN-UP
159.495-160.200	TRUCKING
160.215-161.565	RAILROAD
161.600	MARINE
161.640-161.760	REMOTE PICKUP
161.800-162.000	MARINE PHONE
162.000-174.000	FEDERAL GOVT.
163.250	EMERGENCY PAGING
166.250	REMOTE PICKUP
170.150	REMOTE PICKUP
173.225-173.375	RELAY PRESS, NEWSPAPERS, FOREST, PETROL
174.000-216.000	TV CH 7-13
216.000-220.000	FEDERAL GOVT., TELEMETRY
220.000-225.000	HAM
225.000-400.000	FEDERAL GOVT., MILITARY AIRCRAFT
400.000-406.100	SATELLITE, METEROLOGICAL
406.000-420.000	FEDERAL GOVT.
420.000-450.000	HAM
450.000-451.000	REMOTE PICKUP
451.025-451.150	POWER
451.175-451.750	POWER PETROL FOREST
451.775-452.025	SPECIAL INDUSTRIAL
452.050-452.300	TAXI FOREST PRODUCTS
452.325-452.500	TAXI, FOREST PRODUCTS, TRUCKING, RAILROAD
452.525-452.600	AUTO CLUB, TOWING
452.625-452.950	TRUCKING, RAILROAD
452.975-453.000	RELAY PRESS, NEWSPAPERS
453.025-453.975	POLICE LOCAL GOVT. HIWAY MAINT. FIRE
454.000	PETROL OIL SPILL CLEAN-UP
454.025-454.350	RCC
454.375-454.975	MOBILE PHONE
455.000-456.000	REMOTE PICKUP
456.000-460.000	MOBILE REPEATER UNITS 5 MC. ABOVE REPEATER
460.025-460.550	POLICE REPEATER OUTPUT
460.575-460.625	FIRE REPEATER OUTPUT
460.650-462.175	BUSINESS TRUCKING TAXI
462.200-462.450	MANUFACTURERS
462.475-462.525	MFG. POWER TELEPHONE MAINT. FOREST PROD.

462.550-462.725	GENERAL MOBILE RADIO SERVICE (CB)
462.750-462.925	BUSINESS PAGING
462.950-463.175	SPECIAL EMERGENCY
463.200-465.000	BUSINESS
456.000-470.000	MOBILE UNITS 5 MC. ABOVE REPEATER OUT
470.000-806.000	TV UHF
806.000-809.750	MOBILE PHONE
809.750-816.000	TRUNKED MOBILE PHONE
816.000-821.000	TRUNKED MOBILE PHONE
821.000-825.000	PHONE SATELLITE UPLINK
825.000-835.000	CELULLAR, MOBILE UNITS, NONWIRE
835.000-845.000	CELULLAR, MOBILE UNITS, WIRE
845.000-851.000	CELLULAR CONTROL CHANNELS
851.000-854.750	MOBILE PHONE BASE
854.750-861.000	MOBILE PHONE
861.000-866.000	MOBILE PHONE BASE UNITS
866.000-870.000	PHONE SATELLITE DOWNLINK
870.000-880.000	CELLULAR PHONE BASE, NONWIRE
880.000-890.000	CELLULAR PHONE BASE, WIRE
890.000-896.000	CELLULAR CONTROL CHANNELS
896.000-902.000	PRIVATE BUSINESS RADIO

EXPLANATION OF TERMS AND USEFUL INFORMATION

SPECIAL ENERGENCY: This can be anything from private or police search and rescue to ambulance companies to disaster relief organizations (Red Cross) and can even be beach patrols or school buses.
FIXED SERVICE: These frequencies can be used by any service, both private and government, and are for base-to-base only, no mobiles.
GMRS: This is the General Mobile Radio Service, the "UHF Citizens Band."
FIXED-PORTABLE: For base stations that have portable (hand-held) units not installed in vehicles.
RCC: Radio Common Carrier. These frequencies are assigned to private businesses for mobile telephone (not cellular) use and other uses.
LOCAL GOVERNMENT: This is usually for city or county agencies such as the street maintenance crews, water company, public library security, and the security guards at colleges and universities.

For further details, see the CFR (Code of Federal Regulations) Part II. These books are in all public libraries.

APPENDIX F

HOW CELLULAR RADIOS WORK

WARNING: Monitoring cellular radio frequencies is a violation of federal law, the Electronics Communications Privacy Act of 1986.

The following is for informational purposes only and is intended to reveal not how easily cellular radio can be monitored, which has been widely publicized, but that it is possible to track a particular conversation with a very high degree of success, which has not been well-publicized.

There are people who don't want you to know this.

The frequencies used by the cellular-phone system are public domain information—available to anyone. However, to track a given conversation, it is also necessary to know the frequencies used by the individual cells, known as "sets" or the "formula" used to calculate them. They are listed at the end of this chapter.

HOW THE CELLULAR RADIO SYSTEM WORKS

When a cellular system is installed, two separate licenses are issued by the FCC: one to an established telephone company, GTE for example, which is a "wire" system, and the other to a private company, such as Cellular One, which is a "nonwire" system.

The license allows each vendor to operate on a 10 mc.-wide band.

The nonwire channels start at 870.030 mc., and the wire system starts at 880.020 mc. Each channel is 30 kc. wide, which makes 333 channels each. They are arranged in 21 groups of 14 or 15 channels, and each group has one control or data channel.

The area in which they operate is divided into cells. Each cell has a main computer-controlled transmitter and receiver, and a secondary system goes in areas that have heavy use. Each cell computer system uses one group, and adjacent cells never use the same frequencies to prevent them from interfering from each other, although now and then, you may hear parts of another conversation bleeding over from another cell.

The cell computer systems, or sites, are about five miles apart, except in areas where there is heavy traffic or tall buildings and mountains, in which case they will be closer. San Francisco, for example, is 49 square miles in area but has seven sites that I know of. In San José, site 31A is in the 1900 block of S. Bascom Avenue, 32A is just a couple of miles north in the 3000 block of Tiche, near Interstate 880, and there are two sites in the Palo Alto/Menlo Park area, both near Stanford University, one of the most heavily used areas in the country.

Each vendor's system consists of the central office (CO), mobile telephone switching office (MTSO), cell sites, and mobile terminals (MT, cellular telephones).

The CO controls the MTSO, which controls the cell-site equipment, which control the MTs. When a cellular phone is first turned on, the receiver scans all twenty-one of the control or data channels, measures the signal strength of each, and locks onto the strongest one. This places the phone in that cell.

When the user makes a call and presses the send button, the number called and a series of codes are sent on the data channel to the cell-site computer.

These are part of the phone's number assignment module (NAM). Some of these are:

MIN: Mobile Identification Number, the telephone number assigned to the cellular phone.

ESN: Electronic Serial Number, unique to each phone. The EIAA interim standard, IS-3-B, defines the ESN: "The serial number is a 32-bit binary number that uniquely identifies a mobile station to any cellular system. It must be factory set and not readily alterable in the field . . . Attempts to change the serial number circuitry should render the mobile station inoperative."

Two to the 32nd power is 4,294,967,295, or 4.3 billion possible numbers. (The ESN is sometimes in the NAM or other chip or hidden elsewhere inside the phone.)

SIDH: System Identification Number, Home, which tells where the phone was assigned, its home area.

SCM: System Class Mark, the class and power output of the phone.

IPCH: Incoming Page Channel, the channel used by the phone to listen for an incoming call. The wire vendor phones use channel 334 and the nonwire use 333.

ACCOLC: Access Overload Class, certain phones have priority over others when the system is overloaded by too many callers trying to use it at the same time. The phones issued to law enforcement and federal intelligence agencies, emergency services, and the military have first priority: their phones can access the system when others are locked out. This number tells the system the level of priority the phone has.

PS: Preferred System, sets which of the two vendors the phone's account has been established on, wire or nonwire.

LD: Lock Digit, a feature that allows the owner to call his cellular phone from any other phone and enter a code number that will prevent it from being used should it be lost or stolen.

The computer reads the ESN and compares it with the MIN number to make sure they match, identifies the unit, and verifies that it is a registered unit, that the unit has not been shut off for one reason or another (reported stolen or bill not paid). Then the computer finds an unused channel based on the information received on the control channel and makes the call.

While this is happening, the computer is frequently checking the signal strength of the mobile unit. If the person calling is out in his car driving around, the signal will get weaker as he gets farther from the location of the cell's computer system.

If the signal strength falls too low, the mobile unit starts looking through the twenty-one control channels again, looking for a stronger one, which will be in another cell—usually but not always the cell that is physically closest.

If someone were listening on a scanner, he would hear a low buzz just before the channel changed.

Meanwhile, all that is happening on the control channels is being monitored by the main switching office, which controls the whole system (all the cells and all the channels for the vendor).

Then the switching office will locate a vacant channel in the new cell and send the mobile unit a code that causes it to switch to the new frequency. This is called "handing off."

When a call is placed to the MT, a page call is sent from the telco office to the MTSO, which sends it out on one of the two IPCH channels. The MT (if turned on) hears all these, and if it recognizes its own MIN and the owner answers, it responds by sending back its ESN. Then the MTSO selects a vacant channel and makes the connection.

If it is not answered, then the MTSO intercept recording comes on with a message such as, "The person you are trying to reach is not available," or "The cellular phone you are calling is out of range or is not turned on."

As long as a cellular phone is turned on, it is communicating with the nearest cell computer, and the system can tell where the phone is. In an area with many cells close together, such as a large city, it can locate the phone to within about a quarter mile or less.

The information that is passed back and forth between the MT and the cell site transceiver is called "capture voice channel assignment," and is in a frequency shift code called "Manchester."

The technical specifications for all this are found in *Recommended Minimum Standards*, publication EIA/15-3-B, available for $21 from the EIAA at 2000 "I" Street NW, Washington, D.C. 20006.

LISTENING AND TRACKING CONVERSATIONS

How well one can hear cellular phone conversations in general and track one in particular depends on three factors:

1. the scanner's quality and channel capability
2. The location of the listener and the antenna
3. How the scanner is programmed

There are a number of scanners available that work very well for cellular listening. One of the best is the AR-3000, which has a 1,000-channel capacity when interfaced with a computer. It can be programmed so that the channel sets are in separate banks, and the banks can be scanned in any order desired. The cost of the AR-3000 including the computer software is about $1300. The Realistic PRO-2006 is another good unit. Both are available from Scanners Unlimited and EEB.

The 2006 can have memory chips added to increase the number of channels to 1,000, which will cover all the cells for both vendors.

Whichever scanner you use, programming 333 to 666 channels into it means pushing from 3,000 to 6,000 keys, and one mistake can cause you to lose a conversation you would otherwise have been able to track.

LOCATION AND ANTENNAS

Obviously, you will hear more in a heavily populated area that in a rural setting. In the open countryside, there may be only one cell transmitter for several miles, but in big cities they may be only a mile apart.

No matter where you are, the better your antenna and the higher its location, the better reception will be. Using a good-quality coaxial cable and replacing it once a year or so also help. Scanner World, USA has a number of good antennas.

PROGRAMMING

How one may want to program the scanner depends on the area in which one is located and how many channels they have. Most scanners have ten banks, but there are twenty-one groups of cellular frequencies. Tracking requires the ability to switch from one group to another as well as a good idea of which group to switch to.

Some of the twenty-one groups will be effectively out of range, again depending on the location, so ten banks are usually sufficient.

A way that one might start is to select a few channels from each of the twenty-one groups, program them into separate banks, and see how much action there is on each one.

People using cellular phones frequently reveal their location, so keep a list of those reported on each bank, and you will soon know the approximate location of the cell site. Also make notes on the strength of the signal.

After a day or so of listening, you will know which groups are the closest. Then program each set into one of the scanner's banks. This saves reprogramming over and over. This way, if you are tracking a particular conversation, you will have a good idea of which bank to switch to. If you know the general area of the phone you are tracking, when you hear the buzz, you will know the two or three scanner banks to activate.

A look at the cell layout diagram shows that when a phone leaves one cell, there are only six other cells it can move into, and knowing the direction it is moving narrows the possibilities to two or three.

Knowing the area also helps in tracking. If someone is following a conversation and the vehicle gets on a certain freeway, then he will be heading toward only one or two cells, and when the hand-off tone is heard, it is even easier to know which banks to activate.

If someone is serious about tracking, he should get a large map of the area, and after many hours of listening, he should be able to draw outlines of the cell areas.

MOBILE TRACKING

Besides tracking from a base location, one can follow a vehicle from a discreet distance and stay with its transmission, no matter where it goes. This can be done with a scanner, as in the base method, but a better way is to use a frequency counter.

Most counters, either portable or laboratory models, cover the cellular frequencies and will easily pick up the signal within a certain distance, depending on the type, quality, and number of other signals present that can interfere.

Typically, they will work from a few feet to 25 feet or so. However, there are preselectors that increase the sensitivity of the counter and, therefore, its effective range. One of the best, I think, is the APS104 from Optoelectronics. It will increase the range to some 250 feet, meaning you can lock onto a cellular phone from that far away.

Once you have the frequency, it only takes a few seconds to punch it into the scanner's memory or select the bank if it is already programmed.

A person interested in investigating someone could follow him around with a frequency counter and scanner to learn that latter's habits and routines, which yield a wealth of information.

• • •

The following page is a verbatim reprint of an article that I downloaded from a computer bulletin board.

WHAT YOU WILL HEAR ON CELLULAR RADIO

Early in the morning, the system is busy. You will hear people on their way to their jobs—doctors, lawyers, businessmen and women, and contractors. They will be calling their offices to check on their appointments, have their secretaries make lunch reservations, and the like. Sometimes they will be in a foul mood, and you will hear them badmouthing some of their employees or telling them to make up some excuse for them not keeping an appointment they want to avoid.

Sometimes big business deals are made, and people talk openly about how they are going to screw someone over or how something is about to come down on someone. People whose names you would recognize and events that could, and sometimes do, make the eleven o' clock news.

Later in the morning, the system is slower. Bored housewives call their husbands at the office, who often as not really don't want to talk to them because they are so busy.

The early drug deals start around noon, small dealers moving a gram of cocaine or a half-ounce of pot, and business people squeeze in a few calls while on their way to lunch, the same bored housewives call each other on the way to the supermarket to get something for dinner and a bottle of white wine, and talk about charity events and going to the symphony to hear music they don't really like.

Late afternoon it gets very busy. Husbands calling wives to say they will be late because of this or that, or that they are just leaving the office and will be there in fifteen minutes, that they are hungry or horny, or in a bad mood, last-minute business deals and dinner reservations, people checking their voice mailboxes, salesmen calling in their orders, and the like.

Late at night it gets interesting. This is when the bigger drug deals are arranged. You will hear more people whose names you would recognize arranging to buy an ounce of coke or pot, crack dealers calling suppliers, pimps calling their "ladies" to see if they have been "busy" and sometimes threatening to come down on them if they aren't scoring enough.

People out partying call their friends to ask them to meet them at a nightclub or someone's home, people having a good time.

Sometimes you will hear people calling 900 numbers to talk about sex with $10-an-hour-convincing-but-bored women who pretend to care about the callers . . . people who are lonely . . .

Arguments are frequent, mostly husbands and wives or business partners yelling and sometimes making threats against each other.

Then early in the morning, it starts all over again.

• • •

Most of these people think, apparently, that their cellular radio conversations are private. Some of them just assume so, or perhaps have been told so by some person who didn't know any better. Many of them probably never really gave it much thought.

Some believe it because they were told so by the company that sold them their phone, either because the salesperson didn't know any better or because they lied to keep from losing a sale.

An executive of a company not mentioned in this book told me, "It is against federal law to sell a scanner that can receive the cellular radio frequencies." He seemed like he really believed this, but he should have known better. That company manufactures a product that is used in the cellular radio industry.

Perhaps if enough people exert enough pressure on GTE and the government, they will make the new encryption system available to the public. Until they do, I will not buy one.

THE CELLULAR RADIO FREQUENCY SETS

The first channel of each set is the data channel. The rest are voice channels. Some sets have a different number of channels. Each cell transceiver uses one set, and in some areas, a cell may have more than one transceiver.

The frequencies within one cell do not appear to change, although some people in the business claim that they do change, anywhere from every few seconds to weeks, depending on whom you ask. An executive of a company that makes cellular test equipment, not mentioned in this book, told me that they never change. My research indicates this to be true.

The cellular transceivers are duplex repeaters, and these listed frequencies are the repeater output that broadcasts both sides of the conversation. The mobile units are offset by 45 mc.

The first twenty-one sets are band "B," the wireline vendor. The second group of sets, band "A," are the nonwire vendor.

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 01		**SET 02**	
335	880.050	350	880.500
356	880.680	371	881.130
377	881.310	392	881.760
398	881.940	413	882.390
419	882.570	434	883.020
440	883.200	455	883.650
461	883.830	476	884.280
482	884.460	497	884.910
503	995.090	518	885.540
SET 01 (cont'd)		**SET 02 (cont'd)**	
524	885.720	539	886.170
545	886.350	560	886.800
566	886.980	581	887.430
587	887.610	602	888.060
608	888.240	623	888.690
629	888.870	644	889.320
650	889.500	665	889.950
SET 03		**SET 04**	
343	880.290	352	880.560
364	880.920	373	881.190
385	881.550	394	881.820
406	882.180	415	882.450
427	882.810	436	883.080
448	883.440	457	883.710
469	884.070	478	884.340
490	884.700	499	884.970
511	885.330	520	885.600
532	885.960	541	886.230
553	886.590	562	886.860
574	887.220	583	887.490
595	887.850	604	888.120
616	888.480	625	888.750
637	889.110	646	889.380
658	889.740		
SET 05		**SET 06**	
340	880.200	351	880.530
361	880.830	372	881.160
382	881.460	393	881.790
403	882.090	414	882.420
424	882.720	435	883.050
445	883.350	456	883.680
466	883.980	477	884.310
487	884.610	498	884.940
508	885.240	519	885.570
529	885.879	540	886.200
550	886.500	561	886.830
571	887.130	582	887.460
592	887.760	603	888.090
613	888.390	624	888.720
634	889.020	645	889.350
655	889.650	666	889.980

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 07		**SET 08**	
353	880.590	344	880.320
374	881.220	365	880.950
395	881.850	386	881.580
416	882.480	407	882.210
437	883.110	428	882.840
458	883.740	449	883.470
479	884.370	470	884.100
500	885.000	491	884.730
521	885.630	512	885.360
542	886.260	533	885.990
563	886.890	554	886.620
584	887.520	575	887.250
605	888.150	596	887.880
626	888.780	617	888.510
647	889.410	638	889.140
659	889.770		
SET 09		**SET 10**	
342	880.260	348	880.440
363	880.890	369	881.070
384	881.520	390	881.700
405	882.150	411	882.330
426	882.780	432	882.960
447	883.410	453	883.590
468	884.040	474	884.220
489	884.670	495	884.850
510	885.300	516	885.480
531	885.930	537	886.110
552	886.560	558	886.740
573	887.190	579	887.370
594	887.820	600	888.000
615	888.450	621	888.630
636	889.080	642	889.260
657	889.710	663	889.890
SET 11		**SET 12**	
338	880.140	336	880.080
359	880.770	357	880.710
380	881.400	378	881.340
401	882.030	399	881.970
422	882.660	420	882.600
443	883.290	441	883.230
464	883.920	462	883.860
485	884.550	483	884.490

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 11(cont'd)		**SET 12(cont'd)**	
506	885.180	504	885.120
527	885.810	525	885.750
548	886.440	546	886.380
569	997.070	567	887.010
590	887.700	588	887.640
611	888.330	609	888.270
632	888.960	630	888.900
653	889.590	651	889.530
SET 13		**SET 14**	
337	888.110	349	880.470
58	880.740	370	881.100
379	881.370	391	881.730
400	882.000	412	882.360
421	882.630	433	882.990
442	883.260	454	883.620
463	883.890	475	884.250
484	884.520	496	884.880
502	885.150	517	885.510
526	885.780	538	886.140
547	886.410	559	886.770
568	887.040	580	887.400
589	887.670	601	888.030
610	888.300	622	888.660
631	888.930	643	889.290
652	889.560	664	889.920
SET 15		**SET 16**	
339	880.170	345	880.350
360	880.800	366	880.980
381	881.430	387	881.610
402	882.060	408	882.240
423	882.690	429	882.870
444	883.320	450	883.500
465	883.950	471	884.130
486	884.580	492	884.760
507	885.210	513	885.390
528	885.840	534	886.020
549	886.470	555	886.650
570	887.100	576	887.280
591	887.730	597	887.910
612	888.360	618	888.540
633	888.990	639	889.170
654	889.620	660	889.800

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 17		**SET 18**	
341	880.230	354	880.620
362	880.860	375	881.250
383	881.490	396	881.880
404	882.120	417	882.510
425	882.750	438	883.140
446	883.380	459	883.770
467	884.010	480	884.400
488	884.640	501	885.030
509	885.270	522	885.660
530	885.900	543	886.290
551	886.530	564	886.920
572	887.160	585	887.550
593	887.790	606	888.180
614	888.420	627	888.810
635	889.050	648	889.440
656	889.680		
SET 19		**SET 20**	
346	880.380	347	880.410
367	881.010	368	881.040
388	881.640	389	881.670
409	882.270	410	882.300
430	882.900	431	882.930
451	883.530	452	883.560
472	884.160	473	884.190
493	884.790	494	884.820
514	885.420	515	885.450
535	886.050	536	886.080
556	886.680	557	886.710
577	887.310	578	887.340
598	887.940	599	887.970
619	888.570	620	888.600
640	889.200	641	889.230
661	889.830	662	889.860

CHANNEL	FREQUENCY
SET 21	
334	880.020
355	880.650
376	881.280
397	881.910
418	882.540
439	883.170
460	883.800
481	884.430
SET 21(cont'd)	
502	885.060
523	885.690
544	886.320
565	886.950
586	887.580
607	888.210
628	888.840
649	889.470

THE 21 GROUPS FOR THE NONWIRE VENDOR

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 01		**SET 02**	
001	870.030	002	870.060
022	870.660	023	870.690
043	871.290	044	871.320
064	871.920	065	871.950
085	872.550	086	872.580
106	873.180	107	873.210
127	873.810	128	873.840
148	874.440	149	874.470
169	875.070	170	875.100
190	875.700	191	875.730
211	876.330	212	876.360
232	876.960	233	876.990
253	877.590	254	877.620
274	878.220	275	878.250
295	878.850	296	878.880
313	879.390	314	879.420
SET 03		**SET 04**	
003	870.090	004	870.120
024	870.720	025	870.750
045	871.350	046	871.380
066	871.980	067	872.010
087	872.610	088	872.640
108	873.240	109	873.270
129	873.870	130	873.900
150	874.500	151	874.530
171	875.130	172	875.160
192	875.760	193	875.790

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 03 (cont'd)		**SET 04 (cont'd)**	
213	876.390	214	876.420
234	877.020	235	877.050
255	877.650	256	877.680
276	878.280	277	878.310
297	878.910	298	878.940
315	879.450	316	879.480
SET 05		**SET 06**	
005	870.150	006	870.180
026	870.780	027	870.810
047	871.410	048	871.440
068	872.040	069	872.070
089	872.670	090	872.700
110	873.300	111	873.330
131	873.930	132	873.960
152	874.560	153	874.590
173	875.190	174	875.220
194	875.820	195	875.850
215	876.450	216	876.480
236	877.080	237	877.110
257	877.710	258	877.740
278	878.340	279	878.370
299	878.970	300	879.000
317	879.510	318	879.540
SET 07		**SET 08**	
007	870.210	008	870.240
028	870.840	029	870.870
049	871.470	050	871.500
070	872.100	071	872.130
091	872.730	092	872.760
112	873.360	113	873.390
133	873.990	134	874.020
154	874.620	155	874.650
175	875.250	176	875.280
196	875.880	197	875.910
217	876.510	218	876.540
238	877.140	239	877.170
259	877.770	260	877.800
280	878.400	281	878.430
301	879.030	302	879.060
319	879.570	320	879.600

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 09		**SET 10**	
009	870.270	010	870.300
030	870.900	031	870.930
051	871.530	052	871.560
072	872.160	073	872.190
093	872.790	094	872.820
114	873.420	115	873.450
135	874.050	136	874.080
156	874.680	157	874.710
177	875.310	178	875.340
198	875.940	199	875.970
219	876.570	220	876.600
240	877.200	241	877.230
261	877.830	262	877.860
282	878.460	283	878.490
303	879.090	304	879.120
321	879.630	322	879.660
SET 11		**SET 12**	
011	870.330	012	870.360
032	870.960	033	870.990
053	871.590	054	871.620
074	872.220	075	872.250
095	872.850	096	872.880
116	873.480	117	873.510
137	874.110	138	874.140
158	874.740	159	874.770
179	875.370	180	875.400
200	876.000	210	876.030
221	876.630	222	876.660
242	877.260	243	877.090
263	877.890	264	877.920
284	878.520	285	878.550
305	879.150	306	879.180
323	879.690	324	879.720
SET 13		**SET 14**	
013	870.390	014	870.420
034	871.020	035	871.050
055	871.650	056	871.680
076	872.280	077	872.310
097	872.910	098	872.940
118	873.540	119	873.570
139	874.170	140	874.200
160	874.800	161	874.830
181	875.430	182	875.460

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 13 (cont'd)		**SET 14 (cont'd)**	
202	876.060	203	876.090
223	876.690	224	876.720
244	877.320	245	877.350
265	877.950	266	877.980
286	878.580	287	878.610
307	879.210	308	879.240
325	879.750	326	879.780
SET 15		**SET 16**	
015	870.450	016	870.480
036	871.080	037	871.110
057	871.710	058	871.740
078	872.340	079	872.370
099	872.970	100	873.000
120	873.600	121	873.630
141	874.230	142	874.260
162	874.860	163	874.890
183	875.490	184	875.520
204	876.120	205	876.150
225	876.750	226	876.780
246	877.380	247	877.410
267	878.010	268	878.040
288	878.640	289	878.670
309	879.270	310	879.300
337	879.810	328	879.840
SET 17		**SET 18**	
017	870.510	018	870.540
038	871.140	039	871.170
059	871.770	060	871.800
080	872.400	081	872.430
101	873.030	102	873.060
122	873.660	123	873.690
143	874.290	144	874.320
164	874.920	165	874.950
185	875.550	186	875.580
206	876.180	207	876.210
227	876.810	228	876.840
248	877.440	249	877.470
269	878.070	270	878.100
290	878.700	291	878.730
311	879.330	312	879.360
329	879.870	330	879.900

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
SET 19		**SET 20**	
019	870.570	020	870.600
040	871.200	041	871.230
061	871.830	062	871.860
082	872.460	083	872.490
103	873.090	104	873.120
124	873.720	125	873.750
145	874.350	146	874.380
166	874.980	167	875.010
187	875.610	188	875.640
208	876.240	209	876.270
229	876.870	230	876.900
250	877.500	251	877.530
271	878.130	272	878.160
292	878.760	293	878.790
331	879.930	332	879.960
SET 21			
021	870.630		
042	871.260		
063	871.890		
084	872.520		
105	873.150		
126	873.780		
147	874.410		
168	875.040		
189	875.670		
210	876.300		
231	876.930		
252	877.560		
273	878.190		
294	878.820		
333	879.990		

FORMULA FOR FINDING CELLS

The following formula can be used to find all the frequencies used in a cell if only one of them is known and to convert between the frequency and channel number.

Frequency = channel number x .03 mc. + 870 mc.
Channel = frequency - 870 mc. divided by .03

For example, the frequency 880.050.

Subtract 870.000

= 010.050

10.050 divided by .03 = 335.

880.050 is channel 335.
Reverse the formula, using channel 335:

335 x .03 = 10.050 + 870 = 880.050

If you hear a conversation on a frequency, use the formula to convert it to the channel number and find it in the list of sets above.

APPENDIX G

MODIFYING SCANNERS FOR CELLULAR RADIO

THE REALISTIC PRO-2006

The Realistic PRO-2006 is available from Scanners Unlimited, EEB, and other stores that sell quality communications equipment, and it has excellent sensitivity and audio.

To modify it to receive the cellular band, remove the antenna and take off the top cover by removing the two Phillips screws of the top cover from the back. Looking at it from the rear, there is a metal plate that goes across the back of the front panel. On the left side, one corner of the plate is cut away. On the green circuit board behind it is a small screw, and below it are two glass diodes. Use diagonal cutting pliers and clip the wire on the bottom diode and then replace the cover. That's all there is to it.

This is what the newspapers call "very sophisticated equipment."

THE REALISTIC PRO-34

Modifying the Realistic PRO-34 portable scanner is not as easy as with the 2006, but it is not too difficult. You will need a small soldering iron.

Remove the battery holder, lay the scanner face down on your work area, and remove the four Phillips screws from the back. Inside the battery compartment on the bottom of the case are two small plastic hooks and a small paper label with a number like "7A8." Push out on that label with your thumb and the case will come apart.

On the back of the circuit board are four hex-shaped spacers that the four screws from the back cover went to. Use a nutdriver or pliers to remove them.

On the BNC antenna connector is a small bare wire that goes to the circuit board. Unsolder both ends. A second wire goes to the ground foil of the board from the outside part of the BNC connector. Loosen one end of it. (It may be a flat strip instead of a wire.)

At the lower left corner of the board is a small metal can about 1/4 inch square. It has a wire that goes to a small bracket. Unsolder it at the bracket end. Now remove the nuts that hold the volume and squelch controls to the top panel.

Just below the antenna connector is a row of small pins that project 1/8 inch or so. These pins are all that hold the two circuit boards together. Carefully, using a rocking motion, pull the two boards apart. The circuit boards used in the PRO-34 are thin and cheap and break very easily. Don't pull hard, just take your time and do it slowly, or you will ruin a $300 scanner.

As the two boards separate, work the volume and squelch controls from the top panel. Set the board aside. With the antenna connector at your top right, you will see a number of diodes on the left side. Clip one lead of the fifth one from the top. That's all there is to it. Now just reassemble it.

The PRO-34 is not one of Realistic's better products. It is cheaply made, and the one I used to have was not as sensitive as the Uniden scanners. It also does not have memory back-up batteries like the PRO-32, which means that if the batteries go dead, you have to reprogram it.

It also has an annoying beep tone when you use a 120-volt adapter and the batteries are not installed. The Uniden scanners are better and easier to modify.

THE UNIDEN 760 AND 950

To modify the Uniden BC-760-XLT and BC-950-XLT scanners:

Remove the four screws from the back cover. Locate the large Sanyo chip. It will have the number LC3517BM-15 printed on it, and it has thirty-two pins.

On one end of the chip is a small notch. With the notch at the top the pins are numbered from the top left corner, pin 1, down the left side and then up the right side; the bottom left will be pin 16 and the bottom right pin 17.

Pin 26 has two small traces going to it. Cut them with an X-ACTO knife and then carefully solder pins 26 and 27 together. Cool them with a damp sponge as soon as you are done. Integrated circuits are sensitive to heat.

Solder one end of a bare wire 1/2-inch long across pins 19 and 20 and the other end of the wire to the two traces that went to pin 26 before you cut them.

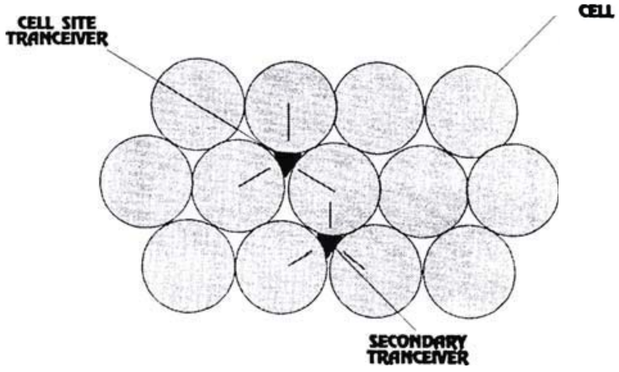
Now turn it on and enter a cellular frequency, and if you do not get an error message you did it right.

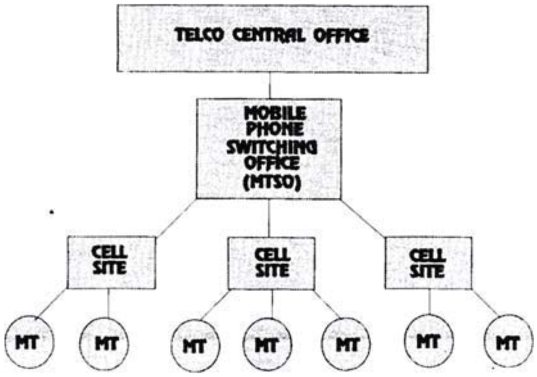
Listening to cellular phones is a violation of the Electronic Communications Privacy Act.

APPENDIX H

THE CELLULAR PHONE NAM LAYOUT

CELLULAR SYSTEM DIAGRAMS





THE CELLULAR PHONE 'NAM' LAYOUT

MARK DEFINITION	most	BIT SIGNIFICANCE	least	Hex address
	0 SIDH (14-8)			00
	SIDH (7-0)			01
LU=Local use	LU	0 0 0 0 0 0	MIN	02
	0 0 MIN2 (33-28)			03
	MIN2 (27-24)	0 0 0 0		04
	0 0 0 0	MIN1 (23-20)		05
	MIN1 (19-12)			06
	MIN1 (11-4)			07
	MIN1 (3-0)	0 0 0 0		08
	0 0 0 0	SCM (3-0)		09
	0 0 0 0 0	IPCH (10-8)		0A
	ICPH (7-0)			0B
	0 0 0 0	ACCOLC (3-0)		0C
PS=Perf Syst	0 0 0 0 0 0 0	PS		0D
	0 0 0 0	GIM (3-0)		0E
	LOCK DIGIT 1	LOCK DIGIT 2		0F
	LOCK DIGIT 3	LOCK SPARE BITS		10
EE=End/End	EE	0 0 0 0 0 0	REP	11
REP=Reprity	HA	0 0 0 0 0 0	HF	12
HF=Handsfree HA=Horn Alt	Spare Locations (13-1D) contain all 0's			13 to 1D
	NAM CHECKSUM ADJUSTMENT			1E
	NAM CHECKSUM			1F

APPENDIX I

GLOSSARY

AC: Alternating current. A current that reverses directions. It starts at zero volts, flowing from plus to minus, builds up to a peak (i.e., the 120 volts used in lighting circuits) then goes back to zero, and builds again to a peak, in the opposite direction, from minus to plus. This is one cycle. The number of times a second it does this is its frequency. House current, for example, is 60 cycles (per second).

ALLIGATOR CLIPS: Small spring-loaded clips made for temporary connections, such as to a phone line. This is a small version of the ones used on automobile jumper cables.

AM: Amplitude Modulation, an RF signal that uses changes in its amplitude (intensity or power, sort of) to carry intelligence.

ANI: Automatic Number Identification. A special, proprietary telco phone number that, when called, will answer with a computer synthesized voice that gives the number from which the call is placed. This is how telco employees, or anyone who has the ANI numbers, can identify an unknown line. A spy could use ANI from a telephone pole, or by tapping a multiline cable in an office building, to find the target line.

ANTENNA: Anything made of metal that is used to radiate a signal and increase the range of a transmitter. The proper length is shorter as the frequency increases.

ASCII: The American Standard Code for Information Interchange. Used in computer data storage and transmission, it has a series of eight ones and zeros used for numbers and letters.

AUTOVON: A phone system used by the military that has four DTMF tones that Touchtone pads can generate but are not included in other telephones.

BABY MONITOR: A type of wireless monitoring device that can use the subcarrier technique or can be an RF device.

BANDWIDTH: The width of a transmitted RF signal. For example, most two-way radios have a signal that is 5,000 cycles (5 kilocycles) wide. TV stations transmit a signal that is 6 megacycles wide. It occupies that much of the radio spectrum. TV channel 2 is from 54 to 60 mc.

BASE BAND: A signal output from a satellite TV receiver that can be used with a shortwave radio to hear satellite phone calls.

B-BOX or BRIDGING BOX: a large metal cabinet, usually on street corners, where the underground phone lines surface so telco workers can access them.

BBS: Bulletin Board System, or RBBS, remote BBS—a computer system accessible by phone using a modem.

BIAS: A weak signal generated by tape recorders to align the small areas of magnetism on recording tape, called domains, previous to sound being recorded. This signal can be detected by special devices made for the purpose.

BINARY: A system of counting using only the numbers 0 and 1.

BINDER GROUP (See also COLOR CODES): Telco uses these color codes to mark pairs of wires. There are two groups of five colors that can mark twenty-five pairs. Each bunch of twenty-five pairs is called a binder group and is marked using the same color code, to separate them from the other binder groups in a large cable.

BIRDIE: An internal signal generated by some scanners, which it "hears" as a station. It is usually heard as a low hissing sound. The newer scanners have eliminated most birdies, but all have a few.

To tell a birdie from a real signal, disconnect the antenna, and if it is still there, it is a birdie.

BIT: See computer terms.

BREADBOARD: A type of connection block used to design electronic circuits. It has rows of small holes that wires from electronic components can be inserted temporarily, eliminating the need to solder them and making for quick, easy changes.

BUG: As used in this book, any type of listening device. The term usually refers to a hidden microphone, alone, or attached to a radio transmitter.

BUG DETECTOR: A device used for finding an RF bug by tuning in on the signal it transmits.

BUMPER BEEPER: A small transmitter hidden in or on a vehicle, which transmits a beep tone and is received by a receiver made for that purpose, allowing the operator to track the vehicle.

BURST: A transmitter that converts sound to digital form, stores it, and then transmits it in a fraction of a second burst. This makes it more difficult to find with electronic equipment.

BYTE: See computer terms.

CABLE: Any number of electrical wires together inside an insulating sheath. It may contain from two to hundreds of wires.

CALL BLOCKING: A feature of Caller ID, in which you can prevent a number you are calling from knowing your number by dialing a three-digit code before you place the call. The person you are calling has the option of refusing calls that are blocked. Call Blocking will not prevent anyone you call from using Call Return or Call Trace.

CALL TRACE: Another feature of Caller ID, this allows the telco to determine the number of the last phone that called you, if you request it. However, the telco will not give you this information, only the police. Like an instant pen register, it is useful in trapping prank callers.

CALLER ID: A new system being offered by the Bell system. A small device attached to your phone will display after the first ring the number of anyone who calls you. It is available only in certain areas for personal phones, but is already in use on all 800 and 900 numbers. Any time you call one of these numbers, they have a record of your number.

CALL RETURN: A function of Caller ID that allows you to call back the last person who called your phone, even if you didn't answer.

CAMA: Centralized Automatic Message Accounting. A feature of the telco ESS that makes a computer record of all local and long-distance calls and stores them on magnetic tape. It is theoretically "for statistical purposes only" but is available to law-enforcement agencies.

CAPACITOR (also called CONDENSER): An electronic component that stores electricity in a DC circuit, and in AC it causes capacitive reactance to the flow of current, like AC resistance, sort of.

CARBON MICROPHONE: A microphone that uses small carbon granules inside a diaphragm. As sound enters, it vibrates the carbon, which changes its resistance, and these changes are heard by a telephone receiver as sound. It requires a DC voltage to make it work, which is why phone lines have DC on them.

CARRIER: An RF signal from a transmitter. It can have intelligence inside it (voices, music, etc.), which is separated by a detector.

CCIS: Common Channel Interoffice Signaling. Part of the new ESS used by telco to defeat phreakers. The dialing tones are sent over a separate line (loop) instead of the voice line.

CELL: A physical area that the cellular radio is divided into. Each cell has one or more computer-controlled transceivers. This is also a place where people can be caged for illegal surveillance. A cell may have a "window," depending on the jailer.

CNA: Central names and addresses. A division of the telco that maintains records of customers, which can be accessed by anyone who knows the numbers and terminology.

COCOTS: Company-Owned, Coin-Operated Telephone System. Privately owned pay phones. Generally easier to phreak than fortresses.

COLOR CODE: A set of colors used in phone wiring to identify the various pairs. It uses the colors blue, orange, green, brown, slate and white, red, black, yellow, and violet. Each pair (line) uses one color from each of the two groups.

COMPUTER TERMS: The following terms make it easier to understand the chapters on data encryption, but otherwise they are as boring to most readers as they were to me in college—in spite of an excellent instructor.

> A computer stores data in binary form, which is a series of ones and zeros, a system of counting based on 2 instead of 10. Each one or zero is called a bit.
>
> In a computer memory chip, each bit of information is stored as a low-voltage level, which can be a zero or a high-voltage level (about 5 volts) which is a one.
>
> Letters and numbers are made up of bytes, and a byte is made of eight bits. A letter would be stored as one byte or eight bits and so would be something like 10001011 or 01110101.
>
> In data encryption, the DES, the data to be scrambled, flows into the program (in the original 64-bit DES) 8 bytes or 64 bits at a time.
>
> These 64 bits are then rearranged, substituted, and transposed according to a prearranged plan, which is the key.

CONTACT MICROPHONE: A special microphone used to pick up physical vibrations, such as from a wall. Sometimes called an electronic stethoscope.

CROSSBAR: A type of telco switching system that was used to connect phone lines together. It used mechanical relays and has been replaced by the ESS in all but a few small telcos.

CYCLE: The number of times per second an alternating current reverses and changes direction. It is also called hertz.

DECIBEL: A unit used to measure the relative strength of an audio or RF signal.

DEMODULATOR: A circuit that extracts the intelligence from a radio or TV signal. It is also called a detector.

DEMON DIALER: See WARGAMES.

DES: The Data Encryption Standard, an encryption program written by IBM for the National Bureau of Standards.

DIODE: An electronic part similar to a transistor, except that it usually has only two layers of silicon instead of three.

DIP: Dual Inline Package, the plastic or ceramic material with two rows of pins that integrated circuits are built into.

DIP SWITCH: A small package the same size as a DIP that contains a number of small slide switches, usually four or eight, and is about 1-inch long and 1/4-inch wide.

DIRECT LISTEN: An eavesdropping method using either a hidden microphone or a phone tap, in which wires lead directly to the listening post.

DISTRIBUTION CLOSET: A place, usually a small, locked room, where the phone lines enter a building and are connected to the various pairs of wires that go to the apartments or offices.

DOWN-LINE: Any place on a phone line outside the house or building, on a telephone pole, or in a telco junction point, etc.

DROP: "Make a drop"—plant, hide, or install a bug or listening device.

DROP WIRE: The phone wire that leads from a telephone pole to a building.

DTMF: Dual Tone, Multifrequency. The audio tones used in push-button telephones.

DVP: Digital Voice Protection, a secure method of scrambling radio telephone conversations. It is made by Motorola.

EARTH STATION: A satellite TV receiving system.

EAVESDROPPING: Any method, electronic or otherwise, of secretly listening to someone's conversations without his or her knowing.

ECPA: The Electronic Communications Privacy Act, a federal law that restricts which radio signals one can listen to legally, among other things.

ENCRYPTION: The process of scrambling letters to make them unreadable without the key or password needed to unscramble them.

ESS: Electronic Switching System, the computerized system the telco uses to connect one phone to another. This system replaced the stepping switches and crossbars.

EXTENDER: Term used for a line that can be used by phone phreakers to make phree calls.

FARADAY CAGE: A metal cage that uses copper mesh or other metal to keep radio waves from getting in or out, named after Michael Faraday, one of the pioneers in electronics.

FEDS: Generic term used here for federal agents.

FET: Field Effect Transistor, a different type of transistor that has a gate, source, and drain as its three parts.

FIBER-OPTIC: A thin glass fiber strand used to conduct light, which can be used in place of phone wires.

FIELD STRENGTH METER: An electronic device that detects the RF signals from transmitters, bugs, etc. It can be as simple as a small meter with a diode across it and a length of wire for an antenna, or a sophisticated and expensive type used by cable TV companies to detect cable leaks. The latter is made by Simpson.

FILTER: An electronic circuit or device that affects sound or RF signals that enter it. It can be used with audio signals to block out interference when used with a bug or shotgun microphone. The equalizer on a stereo system is a filter. Some types are:

- Bandpass—allows a certain range or band of frequencies (either audio or RF) to pass and blocks all others.
- Bandstop—the opposite of bandpass: a certain range is blocked, all others pass.
- T-notch—an adjustable filter that can be tuned to block certain frequencies, like an adjustable bandpass filter.

FLOOR CLOSET: A smaller telephone line distribution closet on some or all floors of office and apartment buildings.

FM: An RF signal that uses a change in frequency to carry intelligence.

FORTRESS: A pay telephone owned by Bell.

FREEWARE: Computer software made available to the public by the author without charge.

FREQUENCY COUNTER: A device that measures the frequency of a radio transmitter and displays it on the front panel.

FREQUENCY HOPPING: The technique of changing frequencies quickly to prevent the transmission from being intercepted. The Secret Service, for example, has 16 channels set aside for this, starting at 408.625 and including every 25 kc. up to 409.000 mc.

GATLING GUN: A type of shotgun microphone using a number of small tubes to make it very directional. Named for the Gatling gun, one of the first machine guns, which it slightly resembles. For details see *The Big Brother Game* by Scott French.

GIGACYCLE: Gc., a billion cycles per second, also called gigahertz.

GOLD BOX: A device for call forwarding, used before the telco had this feature. It requires two lines and can be used as an alibi for people to "prove" that they were home at a certain time. The person calls in on one line and makes a call through the other line. Since the telco keeps a record of all calls, it will show that a call was, indeed, made from that line at the time. The Gold Box can also be used as a remote-control phone tap by connecting it to the target line.

GROUND DETECTION: A system used in pay phones to prevent using a red box to obtain phree calls. It physically senses coins being dropped into the phone but does not count how many. To defeat this, the phreaker first drops a few coins in so the ground detection system will be fooled and then uses the red box.

HACKER: One who breaks into computer systems or telephone systems, voice mailboxes, answering machines, etc. It can also mean a person who has knowledge of computer hardware. The definition depends on whom you ask.

HARDWARE: The physical, mechanical parts of a computer—the circuit boards, disk drives, peripherals, etc.

HARMONIC: A multiple of an RF signal. For example, a transmitter with a signal on one mc. would also transmit on 2, 3, 4 mc. (and so on). These harmonics are "suppressed" in the transmitter and are usually very weak so they don't radiate very far.

HARMONICA BUG: See INFINITY TRANSMITTER.

HAZARD: Term used in sweeping for bugs to mean any place a listening device could be hidden. possible hiding places, or hazards.

HERTZ: See CYCLE.

HEXADECIMAL: A system of counting used in computers, based on 16 instead of 10. It uses the digits 0 to 9 and the letters A to F.

Counting from 0 to 16 would be 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

HOOK SWITCH BYPASS: A switch that defeats or bypasses the cradle or hook switch in a telephone to turn on the microphone (make it hot). It is used with an infinity transmitter.

HOT MIC: A microphone that is turned on, usually meaning the one in a telephone that has been activated by a hook switch bypass.

IMAGE: Image signal, a signal received by a scanner that is on a frequency other than that the scanner is tuned to. It is complicated but similar to INTERMOD. The "sum and difference" frequencies are generated by a circuit inside the scanner called a "local oscillator."

IMPEDANCE: A combination of resistance and reactance.

INDIGENT: A term that describes some writers of books on the subject of electronic surveillance.

INFINITY TRANSMITTER: A device that activates the microphone inside a telephone from a remote location, allowing the user to listen to the sounds in the room where the bugged phone is located. It was once called a harmonica bug.

INFRARED TRANSMITTER: A listening device that uses invisible infrared light to transmit intelligence, much like a TV remote control, except that little about TV is intelligent.

INTELLIGENCE: Generic term for information.

INTERCEPT: To overhear in any of several ways sound or video without the subject's being aware that it is being done.

INTERMOD: Intermodulation. This occurs when you hear a station on your scanner that isn't supposed to be there. When two RF signals combine in space, they mix together and produce the "sum and difference" frequencies of both. For example, station A has its signal on 10 mc., and station B is transmitting on 15 mc. If they are physically close to each other, the signals will mix and generate signals at 25 mc. (sum) and 5 mc. (difference), which can be picked up on scanners. Intermod signals are weak and have short range but cause some interference in large urban areas. Voice and beeper pager systems are the main cause of intermod because they have high-power signals and there are so many of them. More information about sum and difference frequencies can be found in books on the Fourier series, which were written for the purpose of confusing second-year electronics students.

JAMMER or USS JAMMER: A device that generates ultrasonic sound (USS), which causes most microphones to vibrate or oscillate and makes them deaf.

JUNCTION POINT: An underground room, usually entered through a manhole cover (personhole cover?) where telco lines are accessed for splicing and repairs.

KILOCYCLE: Kc., 1,000 cycles, also called kilohertz.

LASER: Acronym for Light Amplification by the Stimulated Emission of Radiation.

LIGHT MODULATOR: A device that causes sound in the target area to flicker the light from an ordinary lamp. The variations in light are converted back into sound at the listening post.

LINE-POWERED: A phone bug that draws power from the phone line and needs no battery.

LISTEN DOWN AMPLIFIER: Any audio amplifier connected to a phone line. It allows the user to hear anything on the line without seizing it (the phone is still "on hook"). If an infinity transmitter is on the line, you will hear the sound it is picking up through the amplifier.

LISTENING POST: Any place used to hear intercepted information. It can be on the premises, in another apartment or office, in a van parked nearby, etc.

LOJACK: A company that makes a special type of bumper beeper transmitter, used for tracking stolen cars.

LOOP: A special, proprietary phone number used in testing lines and such. If two people call the pair of numbers assigned to the loop, they are connected. Examples of loop numbers are: 415-923-9900 and 923-9901. These are old, no longer used.

MANCHESTER: A type of frequency shift code used in cellular radio to transmit the various numbers in the phone's NAM.

MDT: Mobile Data Terminal, sometimes called Mobile Communications Terminal (MCT). A computer terminal installed in a police vehicle that communicates with the base unit by radio. They use an unknown type of code, and no one we know of has been able to break it yet. It is digital and probably encrypted with the DES, which, for all practical purposes, makes it unbreakable.

MEGACYCLE: Mc., a million cycles per second, also called megahertz.

MODEM: Acronym for modulator-demodulator, a device used to convert computer data into sound so it can be sent through the phone lines.

MT: Mobile Terminal, a cellular phone.

MTSO: Mobile Telephone (cellular radio) Switching Office.

MULTIPLEXING: "Many into one," the technique of sending many signals through one wire or cable or fiberoptic strand. There are two methods. In frequency multiplexing, such as cable TV, each signal (channel) has its own frequency. In time multiplexing, each signal, such as a phone conversation, is sampled; a small part of it, a few thousandths of a second, is sent over the line; then the same thing with the next conversation. At the other end, they are recombined by a device called a demultiplexer.

NONLINEAR JUNCTION DETECTOR: An electronic device used for finding bugs by flooding the area with microwaves.

NAM: Number Assignment Module, the chip in a cellular phone that contains various numbers described in Appendix F.

OSCILLOSCOPE: An electronic device that displays electrical signals voltage, etc., on a screen. The squiggly lines on the introduction to "The Outer Limits" TV program were an oscilloscope screen.

OMNIBUS: The Omnibus Crime Control and Safe Streets Act of 1968, a long, complex federal law that concerns surveillance, among other things. It was written to control organized criminals and to confuse everyone else.

OUTSIDE EXTENSION: An extension phone at a different location, such as a second office, or an extension of a business phone at home.

PAIR: Name used for the two wires used by a single-line phone.

PABX: Private Automatic Branch Exchange, a private interoffice telephone system used in businesses and factories, etc.

PBX: Private Branch Exchange, an older manual-type of PABX device.

PARABOLIC MICROPHONE: A disk-shaped device used to concentrate sound. See SHOTGUN MICROPHONE.

PARITY: As used in the section on data encryption, it is a system of checking computer data for errors. When data is transmitted—for example, over a phone line—it is sent in binary form. Each letter and number is 1 byte, which is 8 bits (see computer terms), but numbers and letters actually only use 7 of the 8 bits. The eighth one is sometimes used for parity. Parity can be even or odd (as set by the transmitting computer). Using odd parity, the program counts the number of ones used in the letter being transmitted, and if this is an even number, it adds a one in the unused eighth place (bit) to make it an odd number. At the receiving end, the computer counts the number of "ones" in each letter, and if it is not an odd number, then it knows that a mistake has been sent. Simple, no?

PEN REGISTER: A device used by the telco to maintain a record of all calls made to, or from, a particular number, also called a trap. It can be activated by programming the telco computer, and it can be used to trap prank callers, either by the recipient of the calls or by law enforcement. Before Omnibus there was no law prohibiting the use of them by law enforcement or whomever else. Now a court order is required. See also CAMA.

PENETRATE: To physically enter the target area to place a listening device.

PHONE TAP: Connection of a wire to a phone line or placement of a coil of wire on or near a phone or the line to intercept phone conversations. A tap can be series or parallel.

PHOTOCELL: An electronic component that changes light into electrical energy. It is used in solar-powered electronic devices such as calculators and can be used to power bugs.

PHYSICAL SEARCH: The process of physically searching for listening devices.

PICK: A device used to open locks when no key is available. They come in various shapes, such as ball, diamond, curved, and rake. For more information and illustrations of the actual size and shape of picks, see *The Big Brother Game* by Scott French.

PIRATE BOARD: A computer bulletin board that has stolen calling card numbers, pirated commercial software, telco confidential info, or other such information. Up front, they seem like ordinary systems, but they have secret codes that can be used to access hidden information. These access codes are passed only in person to trusted users.

POCKET DIALER: A pocket-size device that stores the Touch Tones of phone numbers in memory chips. It can be modified to make the sounds of coins dropping into a pay phone and used by phreakers to make free long-distance calls. See RED BOX.

POTENTIOMETER: A variable resistor such as the volume control in a radio or TV.

PROFILE: The composite information one can obtain about a person who has placed a listening device, using various facts such as the type of bug used, where it was placed, etc.

PROPAGATION: The way radio and TV signals act—how they are affected by objects in their paths, sunspots, or other signals. This is very difficult to understand, as radio waves are unpredictable at very high frequencies such as UHF.

PUBLIC KEY: See RSA.

RADIO SPECTRUM: The part of the electromagnetic spectrum where RF transmitters operate.

REACTANCE: The effect that certain electronic components have on the flow of alternating current. It can be capacitive, from a capacitor; inductive, from an inductor (coil of wire); or both. Reactance and resistance together are impedance, sort of like AC resistance.

RECTIFIER: An electronic device that changes AC to DC. AC flows in two directions; DC in only one. A rectifier allows the incoming AC to flow in only one direction. A diode is a rectifier, as are some vacuum tubes.

RED BOX: A portable device used to cheat pay phones by duplicating the sounds of coins dropping. In spite of the telco's efforts to stop this, this device still works.

REFLECTOMETER: Literally, to measure (meter) a reflection. A very sophisticated device that measures the distance to a break or tap of a phone line or cable by sending a signal through the line and measuring changes in the return (reflected) signal.

REMOBS: Remote Observance. An alleged method of telephone surveillance that uses one phone line to tap another from a remote location. The phone companies deny that it can be used this way. I believe that it can, based on personal experience, but this is only my opinion.

REMOTE-CONTROL BUG: An RF bug that can be turned on and off from a remote location. This makes it harder to find and conserves batteries.

REMOTE LISTEN: Using a radio or light transmitter to send the signal from a bug to a remotely located listening post.

REPEATER: A system that uses a larger, higher-power transmitter to relay the signal from a smaller one, increasing the range. Also an amplifier used to boost signals on long telephone lines.

RESISTANCE: The opposition to the flow of direct electric current (DC) in a wire or other conductor, measured in ohms.

RESISTOR: An electronic component filled with ohms that resist the flow of current. Usually made of carbon, turns of small wire, or a metal film.

RF: Radio frequency.

ROOM GUARD: A device used to detect an RF bug when it is brought into the area it is placed in.

RSA: The most secure computer data encryption program there is, also known as the public key system. It is named after the three Harvard professors who wrote it, Drs. Rivest, Shamir, and Adleman. Used with a long key, it is unbreakable even by the fastest computers.

SAM: System Access Monitor, an electronic device that reveals on the front panel the numbers contained in the NAM chip of a cellular phone by detecting its radio signal.

SEIZING: Answering a phone line and causing it to appear busy or in use, an off-hook condition.

SELECTIVITY: A receiver's ability to tune in one station without hearing another on a close frequency, to separate one station from another.

SHAREWARE: Computer programs that are sold at low cost (usually less than $5) on a trial basis. If the user decides to keep it, he is to pay the author of the program a registration fee, usually modest. Some shareware programs are better than commercial software that costs ten to twenty times as much. A good example is the database PC File, available from Buttonware in Seattle.

SHOTGUN MICROPHONE: A special housing used with a microphone to concentrate sound to enable it to hear distant conversations.

SILVER BOX: A modified Touch Tone dialer that has the four pairs of DTMF frequencies not included in standard phones.

SIXTY-SIX BLOCK: An electrical panel used for phone wiring in some large buildings, named for its capacity of 66 phone lines.

SKIP-TRACING: The process of finding people or information that leads to finding people, usually meaning people who have skipped town.

SNR: Signal-to-Noise Ratio, how loud a signal is in decibels in comparison to background noise. A 30 dB SNR is "full quieting," and all of the signal can be heard without any noise.

SNUGGLING: The process of making a bug transmit near the audio part of a television signal. This makes it more difficult to find as the loud buzzing sounds of the TV signal hide the bug.

SPARK-GAP TRANSMITTER: A device that uses high voltage to send a signal through the air. Used for ship-to-shore communications in the early years of this century, it interferes with other transmissions on many frequencies.

SPECTRUM: See RADIO SPECTRUM.

SPECTRUM ANALYZER: A special radio receiver that displays what it is receiving on a video screen. It is useful in finding bugs.

SPSP: Single Pair Station Protector, a small block in a metal or plastic can that connects a single phone line, used in private homes and small apartment buildings. It contains fuses to protect the line and telco equipment from voltage surges.

STEPPING SWITCH: The first automatic system used by telcos to connect lines. Invented by an undertaker named Strowger in the 1890s, it used large, noisy rotating mechanical contacts operated by solenoids.

SUBCARRIER: The principle used in wireless intercoms to send audio through power lines. It is also a method of transmitting other information hidden inside a signal. Muzak, for example, is transmitted on some commercial FM radio stations, and Video-text (closed captioning and other information) is transmitted by some TV stations, hidden in the VBI.

SUBCARRIER DETECTOR: A device for finding a hidden subcarrier bugging device or receiving subcarrier signals on TV channels and FM radio.

SUBCARRIER EXTENSION: An extension telephone that uses the same method as the wireless intercom or baby monitor.

SVX: A more secure method of scrambling radio and radio/telephone conversations that uses the DES. The government uses it so we can't listen to its conversations on our scanners anymore.

SWEEP: Using electronic equipment to search for listening devices.

TARGET: The area to be bugged or line to be tapped.

TDR: Time domain reflectometer, an electronic device that finds breaks or splices in a cable or phone line.

TELCO: Generic term for any telephone company.

TELEMONITOR: A device similar to the infinity transmitter, except that it will not prevent the bugged phone from ringing.

TELETEXT: Information hidden in the VBI. It includes closed captioning for the hearing impaired, news, weather, sports, stock-market information, and more. A decoder to receive this is available from some TV dealers. Zenith makes such a decoder. An unconfirmed rumor is that the feds use teletext to transmit secret information to the local field offices in the nineteenth line of the VBI.

TEMPEST: Acronym for Transient Electromagnetic Pulse Emanation Standard, which has to do with the amount of radiation from a computer system. The details are classified by the NSA.

TEST SET: A special telephone used by telco personnel. It has two alligator clips to connect to the phone wires, and a listen-only mode, among other things.

TORX WRENCH: A tool used to open special "security screws" used on some telco connection blocks, TV cable converters, etc.

TRANSCEIVER: A transmitter and receiver built into one unit.

TRANSDUCER: A device that changes energy from one form to another. A microphone, for example, changes mechanical energy (the movement of the diaphragm) to electrical energy.

TRANSISTOR: An electronic component that consists (usually) of three layers of silicon called the base, emitter, and collector. This is a bipolar-type as opposed to a FET and was invented in 1947 by Drs. Bardeen, Brattain, and Shockley at Bell Labs.

TRAP: Name for a feature of the telco system computer that can make a record of all calls made to the trapped number, used to find prank or obscene callers. Same as PEN REGISTER.

TRIMPOT: A small variable resistor (potentiometer) that can be mounted directly on a circuit board. It has a small screw on the end to adjust it. A trimpot is much smaller than other types.

TROJAN HORSE: A bug placed inside something, then sold or given to the person to be bugged. The gift is usually something that plugs in, such as a table lamp.

TUBE MIC: A small, usually plastic, tube attached to a microphone, then inserted into the target area through a small hole, such as a wall plug, from an adjoining room.

TVRO: Television Receive Only, a satellite TV receiver.

VAN ECK: Dr. Wim van Eck, the engineer who developed the method of eavesdropping on computers from a distance.

VBI: Vertical Blanking Interval. A TV picture is composed of a series of lines "painted" on the screen. Some of these lines cannot be seen on your TV set; they are used for other purposes—the vertical "sync" or "hold," and for teletext information. Adjust the vertical hold until you see the black bar on the screen. In the top right corner on some stations, you will see a series of small black squares that flicker off and on. This is the teletext information in pulse-code modulation. The VBI is the period of time (interval) that these lines that make up the black bar are being painted.

VOICE MAIL DIALER: A computer program that dials phone numbers, looking for voice mail systems.

VOICE MAIL HACKING: The process of breaking into people's voice mailboxes. Computer programs such as "FHACK" find the systems and then hack the passwords. It is available free on some computer BBSs.

WARGAMES DIALER: As in the movie, a computer program that dials phone numbers, looking for other computers and voice mail systems.

WINDOW: That portion of the radio spectrum that is displayed on the screen of a spectrum analyzer, among other things. See also CELL.

WIRELESS INTERCOM: An intercom that uses the power lines to send the sound back and forth, instead of ordinary wires.

WIRELESS MICROPHONE: A small radio transmitter that was designed to eliminate the problem of long cords, used by entertainers. It is often used as a bug.

ZAPPER: My term for sending a high-voltage, low-current burst of electricity down a phone line to burn out a phone bug. Done the right way, it will do just that. Done wrong, it will damage the telco lines or equipment and result in your incurring the wrath of Ma Bell, which translates as all hell breaking loose.

APPENDIX J

SUGGESTED READING

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The Basics

Although surveillance means to keep a close watch over someone or something, a term more appropriate to our discussion is the archaic eavesdropping, which means to listen secretly to what is said in private, the term having derived from the practice of standing under the eaves and surreptitiously listening to a private conversation. Both of these terms describe a practice in widespread use these days, which is the gathering of information from a subject without the subject's knowledge. Probably the most well-known examples of this are practiced by government and law-enforcement agencies by their bugging a room, tapping a phone, or otherwise intercepting private communications, all to gather evidence for intelligence purposes or for prosecution. Almost as frequent are examples of corporate spying, such as bugging the competition to learn of new product lines, technical innovations, or upcoming stock manipulations. Mailing lists, patent information or formulas, financial reports, and the like all can give a competitor a distinct advantage.

Another major segment of the surveillance market involves domestic and private concerns. Divorce cases, child custody disputes, and small-business security (shoplifting, employee theft, and so on) are the grist that keeps many private investigation firms in business (a heavily disputed divorce case can generate more legal maneuvering and attempts to gather incriminating evidence than the most publicized Mafia prosecution).

There are numerous methods by which the bugger can obtain information from the buggee, and the acceleration of electronic technology has widened one's options significantly in the past two decades. The simplest approach involves a hard-wired microphone/recorder combination, several common systems for which are relatively easy to implement. For example, a small, discreet microphone may be hidden on the target premises and connected by a pair of wires to a remote recording device. Alternately, a microphone may be connected to a circuit that modulates the signal onto a 110-volt AC wiring network. (Similar to the wireless intercom systems widely available, this allows an operative to retrieve the signal from any outlet served by the same AC power network.)

A third method involves employing unused telephone cables. Many locations, especially businesses, have a multiple-conductor telephone cable entering the premises. Attaching a microphone and suitable preamp to an unused pair of cables allows one to monitor conversations from any point at which access to the phone wiring exists. Suitable filters are available to prevent "hum" pickup from adjacent AC wiring.

Obviously, hard-wired systems take time to install and require a period of uninterrupted access to the site. However, if properly installed with carefully concealed microphones and wiring, they are extremely difficult to detect because there is no radiated signal.

Microphones may be contact affairs, which are usually mounted in a wall on the opposite side of the room being monitored and pick up sound from the vibrations of the wall. They may also be "spike mikes," which are extremely small microphones built into the end of devices that resemble large nails; such a device can be driven into a wall from the opposite side and will remain virtually invisible from the target side. Most situations employ electret mikes, which are extremely small and very sensitive, with typical units being the size of a pencil eraser. They require a small amount of DC voltage to operate, but this can be applied from the receiving end of the interconnecting cable.

One case we were used in involved a miniature microphone and preamp hidden inside a telephone outlet box and wired to an unused pair of phone cables. The recorder was four floors below in the utility room, where the main telephone exchange was mounted. Disguised as a fuse box, it recorded everything said in the target site. The operator merely showed up periodically to change tapes. Once again, these systems may be hard to install, but properly done, they are extremely difficult to detect.

The most common method of bugging a room undoubtedly involves the use of radio-frequency-transmitting devices. A miniature transmitter with an attached microphone can be hidden almost anywhere. Transmitters have been disguised as fountain pens, cigarette packs, picture frames, plants, emergency lights, smoke detectors, and even an olive in a martini glass (the swizzle stick was the antenna).[1] Winston Arrington, in his excellent book Now Hear This[2], describes a vaginal transmitter; similar to a tampon, it was used at a topless beach to monitor conversations and was obviously well concealed. This is perhaps an extreme example of another category of radio frequency (RF) bugs—the body wire, one of the more common examples of which involves the police secreting a small transmitter somewhere on the body of an undercover agent before he goes out to make a drug buy.

The advantage of these devices is their ease of deployment. In many cases, simply placing an innocuous-appearing object at the target site allows monitoring of conversations from distances of several hundred feet to several miles. The major disadvantage is that these devices transmit on a radio frequency; anyone listening on that particular frequency can hear the same information the operator is monitoring. Problems can also arise because of battery failure.

All of these radio-frequency techniques work equally well with miniature video cameras; a hidden camera connected to a transmitter can send pictures as well as voice to a remote recording location.

Another broad category of surveillance techniques involves telephone bugs and taps. Bugging a phone generally means attaching an RF transmitter to the unit, whereas tapping a phone refers to attaching wires to the phone lines and running them to a remote monitoring or recording post. The terms are often used interchangeably.

Tapping phone lines and taping phone conversations or installing transmitting bugs have become so commonplace that the federal government has instituted laws and regulations regarding the use of such devices (see Appendix A). However, the ease with which these devices may be implemented often overcomes legal considerations on the theory that you're only guilty if you're caught. Given the widespread coverage of the telephone network, surveillance from a remote location is easily possible. Also, the interception of fax and computer-generated information has become so prevalent that security considerations are increasing. A steadily rising number of companies routinely send sensitive documents over the phone lines via fax, blissfully unaware of how easy it is to tap into the line at any point with another fax machine and intercept everything that's being transmitted with virtually no chance of detection. Issue No. 23 of *Full Disclosure* covers this topic at some length. [3]

Phone bugs may also transmit both sides of the phone conversation through the air just like an RF room transmitter (they sometimes use part of the phone wiring as an antenna). There are even units that transmit the phone conversation when the phone is in use and then become room-monitoring transmitters when the phone is hung up.[4]

Of course, one of the simplest methods of bugging a site merely involves hiding a tape recorder on the premises (usually with some form of voice-activation to conserve tape and battery life) and retrieving it at a later date. This also works with cameras and video recorders, a prime example being the "video briefcase," which is a video cassette recorder and camera with a suitable battery pack enclosed in a standard briefcase. Pinhole camera lenses are available that can peer through a hole in the case as small as an eighth of an inch in diameter and still cover extremely wide fields of view.

There are other, more exotic methods of surveillance available to the operative with both the necessary operating skills and an adequate budget.

Infrared transmitter/receiver combinations work on many of the same principles as radio-frequency devices, but they transmit the information via an invisible infrared light beam rather than radio waves. Although this requires the transmitter and receiver to be on a line-of-sight path, there is no radio signal emitted and standard RF sweep techniques do not work.

Even more elaborate are optical systems such as the laser beam reflector, which works because whenever a conversation takes place inside a room, the sound causes surfaces such as windows to vibrate, however minutely, in synchronization with the speech. If an invisible laser beam is aimed at the outside of the window from some remote location, some of the beam will be reflected back by the glass surface and will be modulated by the window's vibrations. A carefully placed detector can intercept this modulated beam and convert it to an exact replica of the conversation taking place inside the room. Although this requires extremely precise aiming, it is a very difficult system to detect.

Although all of these methods are illegal under one or more federal statutes, the possible benefits to the user generally far outweigh the potential penalties imposed, even in the unlikely event the user is apprehended and successfully prosecuted (Richard Nixon might disagree here). Of course, the feds are only guilty if they failed to enact legislation legalizing their tactics. All of the practices prohibited for the public by Title 3 are available to state and federal law-enforcement agencies, although even they must sometimes obtain court approval before implementing them.

Many corporations feel they have no choice but to spy on the competition, this because a surprise technical or tactical innovation can be a matter of life or death in the business world. Catching a soon-to-be ex-spouse in a compromising position can mean major differences in alimony or property settlements, and child custody disputes can generate emotional states that make legal considerations a moot point. Insider stock-trading information, details of planned mergers, impending real estate deals, and access to other privileged information can mean tremendous financial gain for one with advance notice.

The possibility of invasion of one's public or private affairs is so pervasive that security measures have taken on an importance bordering on hysteria. Security firms are turning away business and private countersurveillance consultants are in high demand.

Obviously, because of the numerous surveillance methods available to the bugger, the countersurveillance expert must possess a wide range of knowledge and the proper tools and diagnostic equipment, and must have a precise procedure to apply when searching a premises. Assuring a client that his site is clean only to find out later that there was a hidden bug you missed can ruin your professional reputation in short order.

In the coming chapters we'll take you through the process step by step, including the physical inspection, RF sweep, phone line security analysis, and much more. We'll explain what tools are necessary or useful and show you how to use them. Construction details for several useful pieces of test equipment are outlined and a list of suppliers of commercial units is included. Excerpts from appropriate federal regulations are reprinted and a bibliography of pertinent publications follows.

ENDNOTES

1. Holt, Patricia. *Bug In The Martini Olive and Other True Cases from the Files of Hal Lipset, Private Eye*. New York: Little, Brown and Co., 1991.

2. Arrington, Winston. *Now Hear This*. Chicago: Sheffield Electronics, 1988. An excellent book on the design and construction of bugs and telephone surveillance equipment

3. *Full Disclosure*. Attn: Glen Roberts, Box 1533, Oil City, PA 16301

4. Sheffield Electronics Model TEL-115K. 7223 Stony Island Ave., Chicago, Illinois 60649. Sheffield provides kits for surveillance transmitters of exceptional quality and value.

The Physical Inspection

As an example of how a countersurveillance investigation is conducted, let's go through a typical situation from start to finish. We'll be using a commercial business site as an example, but everything covered would apply to a private residence as well. For brevity we'll call the entire process of physical inspection, RF inspection, phone line security analysis, and so on a "sweep."

Assuming you (the sweeper) and the client have arrived at a contractual agreement (it is difficult to imagine a situation where one would agree to do a sweep without some kind of legal contract), the first step is to determine the scope of the investigation. Some clients may only wish to have their phone lines vetted to make sure they're "clean." Others may want a full-fledged sweep of the entire building. Obviously, some degree of common sense comes into play here and you must put yourself on the other side of the fence and ask "If I wanted to bug this place, what would be the easiest and most effective method? What would be the easiest way to gain access? What kind of information do I wish to obtain? How much is that information worth to my client and how much time and expense do I want to expend to get it?" (Keep in mind that most bugs are as difficult to retrieve as they are to plant; they are usually left in place and written off as a fixed expense.) For a simple divorce case (if there is such a thing), it's highly unlikely that sophisticated laser techniques and the like would be employed. On the other hand, the research and development branch of a major corporation might be well advised to have every possibility investigated.

Another service complementary to the actual sweep involves installing electronic countermeasures (ECM) equipment, which are devices intended to disable, mask, jam, or otherwise render ineffective any surveillance gear already in place. There is also the matter of evaluating existing security and burglar alarm systems and instituting training programs for the staff in security and countersurveillance considerations. (These areas will be covered in a separate chapter along with on-going programs of periodic re-inspections.) The scope of services to be performed should be clearly spelled out in the contract in advance.

The next decision is whether the sweep should be a covert operation, for to warn your enemy that he's been discovered is to give him yet another weapon. If the bugger becomes aware that his target premises is undergoing a sweep, he has several options. For example, many transmitters are duplex affairs, meaning that they can be shut down from the listening post with a simple radio command. This totally defeats the sweep process—you can't find it if it isn't operating. Alternatively, the bugger might just wait until the sweep is completed and then plant another bug.

Sometimes the client doesn't care if the bugger knows his devices are being hunted for, and on occasion time is so critical that discretion must be sacrificed. If the board meeting starts in one hour and the chairman is paranoid about the possibility of a compromised room, a covert operation is almost impossible.

Another possibility worth consideration is the option of disinformation. If a client knows he is being monitored, he may wish to discuss matters of a false or misleading nature to purposely confuse the information gatherer. This can also provide a means of identifying the bugger; providing a critical piece of data to the surveillance system, anyone later displaying a knowledge of this "tagged" information becomes a suspect.

In most cases, however, a discreet, covert operation is in order. This generally involves conducting the sweep when the staff is away (there's always the possibility the bugging was an inside job). Usual procedures involve night sweeps when the business is closed, which eliminates having to answer lots of questions and keeps unnecessary people out of your way.

It's generally most effective to have at least two people on the sweep team. Three or four are best because a complete sweep is quite time consuming, and any larger force makes it difficult to camouflage the operation. Many operatives employ disguises on the theory the building may be under visual surveillance as well, and a troop of technicians lugging anvil cases full of test gear through the front door late at night is highly suspect. One of the better firms we've seen dresses their operatives in coveralls and arrives in a van marked as a janitorial service. A large dolly similar to those used by cleaning crews and festooned with mops and brooms hides the equipment and makes it easy to wheel everything right through the door.

Once inside, normal conversation about cleaning functions or whatever is appropriate, but a set of code words or hand signals should be devised to communicate anything relating to the sweep. Even if the bugger's listening post is shut down for the night, any voice-operated tape machines will still function, and if the bugger listens to the tape the next day and hears one of your guys shout "Hey, come check this out. I think I've found one!," the bugger will have a pretty good idea of what went on.

It also helps to have a floor plan of the entire building in advance and to have assigned tasks to the various team members so that, once inside the building, the sweep can commence with a minimum amount of confusion and wasted time. As the search proceeds, suspicious or vulnerable areas should be indicated on the diagram.

More bugs are probably found during a thorough physical search than by all other techniques combined. It's also about the only way to find hard-wired mikes and hidden tape recorders. The first thing to do is visually check for any signs of hidden cameras, because if there are any in operation, the bugger will know immediately what you're up to. Unfortunately, any bugger worth his pay will have concealed them so well that they will take quite a bit of ferreting out to locate. Besides, if they are obvious enough for you to see them, the client will probably have spotted them himself.

Some sweepers will check for video transmissions on all the common bands from outside the building before they even enter. If there are no unusual signals present, they can be relatively certain that no video transmitters are in operation. However, it is still possible for a video transmitter to be present in a dormant state, waiting to be triggered by a motion sensor. If video transmissions are present, these transmissions can then be effectively jammed, but this will also alert the bugger of an impending search.

It's less likely you will pick up audio transmissions from an RF bug while outside the building because most of these units are voice-operated to conserve battery life (and to prevent you from doing just what we're talking about). Common audio frequencies can be checked en masse with a spectrum analyzer and whip antenna. Any strong local signal's amplitude will stand out quite noticeably. More about this when we get into RF sweeping.

Once the team is inside and the equipment is unpacked, the members go about their various tasks. One group is assigned the job of checking all likely hiding places on the walls and floor, which typically involves removing covers from AC outlets, TV outlets, thermostat housings, and any other wall covering that might conceal a bug. They pay particular attention to AC outlets because many transmitters are mounted in or near them to gain access to the 110-volt wiring for their power source, thereby eliminating the hassles common to battery-powered units. Heating and air-conditioning duct covers are also possibilities but are rarely used because, if they are in operation, the noise of the moving air will mask anything the mike might pick up.

Another group checks light fixtures, smoke detectors, and so on, and if there is a drop ceiling, removes sections to check for anything hidden above them. One popular video camera mount is disguised as a ceiling sprinkler system. The camera is mounted above and has a pinhole lens that looks down through the sprinkler nozzle, which has a tiny mirror mounted at 45 degrees to permit a horizontal field of view.

It's virtually impossible to list all the places a transmitter may be hidden, such as hollowed out books, VCR cassettes, clocks, table lamps, and filing cabinets, to name a few. Anything that could possibly hide a bug, no matter how remote that possibility might seem, should be investigated.

Another step is checking telephones. On a standard handset, the covers over the mouthpiece and earpiece can be unscrewed (an oil filter wrench is handy for this purpose). The elements will drop out and any bugs should be visible. A common method of quickly planting a bug uses "drop-in" transmitters, which are bugs built into the back of a microphone element identical to the ones used in standard phones. The operative simply unscrews the mouthpiece cover and switches elements. Although the range is fairly limited (approximately 100 feet), this is an extremely quick method of deploying a bug.

Popping the cover off the base of the phone is relatively easy and should reveal any internal bugs or induction pickups. If the phone plugs into the wall with a modular plug, unplug it before doing these checks so the noise generated will not be picked up by any line taps. Don't forget the covers over the terminal boxes and modular jacks, and be sure to check any answering machines as well. If there is a fax machine or computer modem attached, a thorough physical inspection is in order.

Another point worth mentioning here is that if you locate a bug, don't pack it up and start making out the bill. Any surveillance job worth the fees most operatives charge dictates several back-up units. We've heard of commercial offices with several phone taps, a couple of RF transmitters, and a hidden tape recorder to boot. A standard trick with phone taps is to install one fairly obvious unit with a secondary device much more deeply hidden. The sweeper finds the first tap and shouts "Eureka!," assuming the phone is now sanitized, and then completely overlooks the second transmitter. The more critical the application, the higher the likelihood of multi-layer devices.

As we've said, a physical inspection is about the only method available to find hard-wired systems. An operative will generally prefer to use existing wiring to get his signal to the outside world, where it can be taped or transmitted. The most common approaches use phone lines, intercom wiring, burglar alarm wiring, and cable or antenna television distribution systems. Intercom stations and burglar alarm sensors should be inspected carefully for any signs of tampering. A scope is handy here. More later.

One common method of sending a video signal from a hidden camera involves modulating, or mixing, this signal onto existing television cabling, often as an upper UHF channel. The signal propagates along the coaxial cable right along with the legitimate signals. All the bugger has to do is tap into another outlet served by the same source (antenna or cable feed) and tune in his signal. This is especially common in structures such as motels and apartment buildings where all the rooms share a common signal source. You should have a portable TV, preferably one with manual tuning on both VHF and UHF. Attach it to an outlet and dial from below channel 2 to above channel 83, watching for any bogus signals. A spectrum analyzer is handy for this task as well (see Chapter 4).

Hidden audio and video recorders are also best located with a physical inspection. Although there are units that will detect the minute amount of radiation thrown off by the recorder's bias oscillator circuitry, they need to be extremely close to register anything, and proper shielding of the recorder will prevent even that. Again, the maxim is if in doubt, take it apart.

Only experience can tell you how much time to spend on the physical inspection before moving on to the more active phases of RF sweeping and live-phone-line analysis. If the room is an office with lots of equipment and furniture, a thorough physical inspection can take all night. Conversely, a conference room, with minimal furniture and fixtures, can be analyzed in short order.

When in doubt, move on to the next phase. If you detect unusual transmissions or radiations, you can generally zero in on them enough to narrow the area of search.

Next comes the fun part: checking the electromagnetic spectrum from DC to daylight to look for active radiating sources. (The electromagnetic spectrum consists of varying wavelengths, one of which is a DC wavelength. Another is a sinusoidal wave of daylight.)

RF Transmitter Bugs

In this chapter we'll discuss bugs that transmit on radio frequencies. To effectively search for them, it's necessary to know how they operate and which frequencies they commonly use.

The electromagnetic spectrum is measured in cycles per second, which is the number of times the electromagnetic field changes polarity. Cycles per second is now commonly referred to as Hertz, in honor of Heinrich Hertz (no relationship to the car rental company), a 19th century German physicist who applied theories to the production and reception of radio waves. Somehow, cycles per second still seems more descriptive. However, we'll use the standard nomenclature Hertz.

Those audio frequencies to which the human ear responds range from 20 Hertz to 20,000 Hertz. Common abbreviations are "kilo" to represent 1,000 and Hz as shorthand for Hertz. This range of 20 Hz to 20 kiloHertz (kHz) is the range that the microphones employed in surveillance gear pick up.

In practice, the pick-up range or "frequency response" of these microphones and transmitters is often limited to a range from about 200 Hz to 3,000 Hz (3 kHz). This is often referred to as "Ma Bell" frequency response because the phone company found that this range contained all the fundamental frequencies of the human voice. Multiples of these fundamental frequencies, called harmonics, add subtle shadings and colorations to the basic tones and allow one to distinguish between, say, a piccolo and a flute, but this subtlety is unnecessary for intelligent recognition of voice communications. Neither the surveillance man nor the phone company is interested in transmitting studio-quality high fidelity, especially since it takes more bandwidth—and hence more power—to accommodate the wider frequency response. This technique also eliminates unnecessary sensitivity to low frequency pick-up, such as 60 Hz power-line hum, and high-frequency noise (amplifier hiss).

Once we get above the audio range, we start dealing with what are known as radio frequencies. These are frequencies which, when traveling down a wire, radiate a signal into space. This is precisely the principle on which antennas operate.

There are acronyms for various groups of frequencies, such as VLF (very low frequency of several hundred kHz or so), VHF (very high frequency of 30 to 300 MHz), UHF (ultra-high frequency of 300 to 1,000 MHz), and so on. (See Appendix D for a chart of frequency allocations used for various services and note the vastly differing bandwidth required by different types of transmissions.)

A voice transmitter essentially takes an input signal, in this case the signal from the microphone, and impresses it on or modulates a higher frequency signal, known as the carrier frequency. In the amplitude modulation (AM) mode, the audio frequencies are used to change the magnitude (amplitude) of the carrier frequency. In the FM mode (frequency modulation), the audio information is used to change the frequency of the carrier up or down by a small amount (known as deviation). The receiver senses these slight variations in the frequency of the carrier and converts this information into a replica of the original audio modulating signal (see Appendix D). These carrier frequencies range from a few hundred kHz up to several billion Hz. A million Hz is abbreviated MHz for megaHertz and a billion Hz (1,000 MI-Lz) is referred to as a gigaHertz or GHz. FM is generally the only practical modulation method for surveillance transmitters. AM is considerably less efficient and is subject to noise and interference, whereas single sideband (SSB) techniques require a considerably more complex transmitter design, which increases size to an unacceptable degree.

There has been some recent use of digital and pulsed-signal transmission similar to the way a computer would send a signal over the phone lines (see Appendix D), which has the advantage of being indecipherable to anyone without the proper decoding unit, but size and complexity again become problems. This technique is rarely used outside the federal sphere. However, most remote control transmissions, such as garage door openers and radio control signals for model airplanes, are digital. These signals generally have to convey a limited amount of information, usually a variety of command codes to turn devices on and off. Voice communications using this method are a vastly more complex task. The new compact discs (CDs) and digital audio tape (DAT), as used in high-fidelity sound systems, sample the audio frequency of the sound rapidly and convert the instantaneous frequency to a train of pulses. On replay, the unit reconverts these pulsed signals into an analog audio signal nearly identical to the original. To maintain fidelity, however, the sampling process must occur at an extremely rapid rate, which results in a very complex coded signal. The circuitry necessary to accomplish this is much too cumbersome for most covert applications.

EFFICIENCY AND PROPAGATION

It's important to have an understanding of where various services are located in the spectrum, and also how signals travel (propagate) at these frequencies. Lower frequencies, which have longer wavelengths, tend to follow the curvature of the earth and penetrate intervening structures more easily than higher frequencies with their shorter wavelengths, which travel a straight path (line-of-sight) but are more easily absorbed (attenuated) by any obstacle.

One other factor: any transmitter will work most efficiently or deliver it's maximum power output capability into an antenna that is some sub-multiple of its wavelength. Most common antennas are either one quarter or one half of the wavelength of the frequency the transmitter is operating at. A one-half wave antenna for 30 MHz is approximately 16 feet long, whereas at microwave frequencies we're talking several inches or less (see Appendix D).

Both the propagation characteristics and the antenna length set some limits as to the frequencies available for practical transmission from a surveillance transmitter. There's also the matter of efficiency—how much power does the transmitter consume versus how much power it radiates from its antenna? This becomes a critical factor for battery-operated transmitters. More on this in the appendices (see power formula and battery table in Appendix C).

From much experimenting in the field and theoretical considerations, it has been found that the optimum performance from a bug will occur somewhere in a band from about 30 MHz to 500 MHz or so. Below this range, efficiency, antenna length, and transmitter size become problems, while above it, propagation problems and attenuation limit their usefulness. There are some microwave bugs in use, but the line-of-sight requirements limit them to special situations only. Low-frequency transmitters (30 to 500 kHz) are primarily used for marine applications. These applications typically require extremely long antennas (several hundred feet) but give extremely long range, especially for voice or code applications.

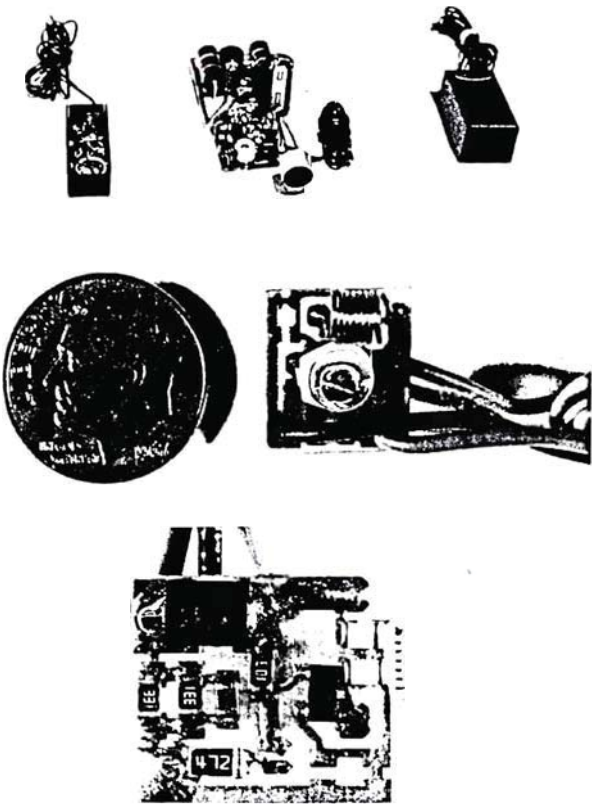
COMMONLY USED FREQUENCIES

Probably the most common frequencies used lie in or near the commercial FM band. A glance through any electronics magazine will reveal an incredible number of companies offering "FM Wireless Mike" kits. Designed to broadcast your own voice through your own FM radio, they are rarely, if ever, used for this purpose (see Chapter 4). By selling them as kits, the companies circumvent the FCC prohibition against sale or shipment of surveillance transmitters to the public. They are not considered RF interception devices until they are assembled, and the average surveillance operator has a box full of them. They're also easy to monitor; any reasonably sensitive FM receiver will suffice. Unfortunately, they are also the least secure because anyone within range with an FM radio who happens to tune across the same frequency will also hear the monitored conversation. There's no point in doing a covert surveillance if everyone else in town is listening in. This also increases the likelihood of the target picking up his own signal. If the buggee is tuning his FM receiver and hits the same frequency as a transmitter operating nearby, a feedback situation occurs, usually a high-pitched whine identical to the squeal you hear at concerts when the musicians turn their amplifiers up too high and the sound gets back into the mike. It goes round and round, starting out as a low-pitched rumble and ending up as a screech.

Obviously, the surveillance operative would like to have his bug operate on a vacant frequency as far from commercial services as possible. Unfortunately, space in the spectrum is at a premium and it's almost all in use for one purpose or another.

Another problem is the availability of commercially manufactured transmitters. Most companies who make these units will sell only to federal agencies or law-enforcement groups because they can get into serious difficulties for selling to the general public.

One exception to this exists in the two commercial business bands. These bands are designed for two-way communications for businesses such as cab companies, delivery services, and so on. Technically, to operate on these bands one must apply to the FCC for a license and be granted a specific



Radio frequency transmitters.

frequency for his own private use. (Generally, no one else within a 60-mile radius is granted the same channel.)

It is the responsibility of the purchaser to apply for and obtain a license, but there is widespread abuse of this requirement. The lower band runs from 150 MHz to 170 MHz, but the upper half (above about 160 MHz) is used by many police and law-enforcement groups and is studiously avoided by any intelligent surveillance types (see Appendix D). The other band starts at 450 MHz and is less densely populated than the 150 MHz band. Even though this band has a lot of activity, especially in a densely crowded urban area, the availability of off-the-shelf gear often offers the only choice for an operative who is unwilling or unable to build his own transmitters or modify existing products.

Theoretically, a surveillance agent could apply for a business license and have his own frequency assigned, but eavesdropping is an invasion of privacy and is not considered a legitimate business. Quite the contrary, because intentionally intercepting transmissions is a criminal act, the operative would not want an intercepted surveillance transmission to be traced to him simply by someone looking up who's licensed for that frequency. Hence, most use of these bands is rather clandestine. In small towns and rural areas, where band activity is sparse, chances of interception decrease proportionately.

The 450 MHz band has been gaining popularity because it requires shorter antennas and is more immune to interference because of the relative inactivity. However, it does have more problems with line-of-sight propagation characteristics.

There are two other major advantages to this gear. First, the transmitters are usually crystal controlled. That means their operating frequency is fixed and maintained by means of a precisely ground quartz crystal, which eliminates the transmitter's drifting off frequency. All FM wireless mikes, for example, use a tunable, uncontrolled oscillator to set their operating frequency. Changes in temperature, aging batteries, and movement of the unit all can cause the signal to drift away from its original frequency. If you're continually monitoring the receiver, this can be corrected by slight retuning of the receiver. However, unattended recording becomes a real problem because it doesn't take much of a frequency change before the receiver loses its ability to lock onto the signal.

The other major advantage has to do with the receiver. Most receiving units designed for these signals have what is known as adjustable squelch. This is a circuit that turns off or mutes the output of the receiver when there is no actual modulated signal, and only gives an audio output when a sufficiently strong signal is being received, i.e., whenever there are voices being transmitted. This makes connection to a tape recorder with voice-activated turn-on much simpler (see Appendix C).

One final topic here before we discuss actually locating these devices. A bug is, by its very nature, a small, low-power transmitter that is small for ease of concealment and deployment; and low power not only to conserve battery life (if batteries are the power source) but also because the monitoring station is usually in the vicinity and there is a distinct liability in having the signal propagate any farther than necessary. This would increase the likelihood of someone else intercepting the transmission. Nonetheless, because you will be very close to it when you're hunting for it, the bug will still sound like one of the strongest signals on the dial.

Now to the hunt.

RF Transmitter Sweeping Receivers

To do a successful RF sweep, several pieces of equipment are necessary. At the top of the list is a sensitive FM receiver that will cover from 20 or 30 MHz to at least 500 MHz with no gaps. Although hand-held scanners will suffice, they are difficult to fine tune. A general coverage communications receiver with manual tuning is a much better choice.

Battery operation is also desirable because you'll be moving it around quite a bit. Additional features should include selectable bandwidth (wide band/narrow band FM modes), adjustable squelch threshold, a headphone jack that disables the built-in speaker, and a reliable and sensitive signal-strength meter.

Yaesu, ICOM, AR, Panasonic, Kenwood, Sony, and others all make general coverage communications receivers designed to operate off 12 volts, such as a car's electrical system, which meet the above requirements. We use a Yaesu general coverage receiver with a short telescoping whip antenna. It's about the size of a cigar box and we hang it from a neck strap for easy portability. It has a 12-volt input jack on the rear panel, and we carry several 12-volt rechargeable Gel-Cells in ammo pouches worn on a web belt (available from your local army surplus store). Spare batteries are highly recommended because the primary one usually dies just before the job is finished.

Two other items complement the receiver package: a cassette deck or boom box with a tape of elevator music or some other innocuous-sounding tunes that might be played as background music in many buildings, and a good set of headphones.

The purpose of the cassette system is to generate sounds for the bug(s) to pick up, which will hopefully be quite innocent to the surveillance monitor but which you can identify when you tune the signal in on your receiver. Many bugs require an incoming signal from the mike (VOX or voice-operated relay) before they power up and start transmitting.

The headphones are necessary to prevent feedback loops from occurring when you hit the bug's transmission signal. If you were to use the built-in speaker, it would reproduce the same signal the bug was hearing and transmitting, resulting in a feedback situation such as we described in Chapter 3. This is a dead giveaway to the monitor that a sweep is in progress. A good set of phones, preferably the surround or earmuff type, are invaluable—they cut out background noise and eliminate distraction. A mixer can be incorporated to feed signals from your associates' walkie talkies if desired (see Appendix C).

The usual procedure is to play the tape at moderate levels in the room under test and, while listening through the headphones, slowly tune the receiver from one end of its frequency range to the other. If there is an active bug in the room you'll hear your own tape when you hit the frequency on which the bug is transmitting. Once you've locked in on the signal, moving around with the receiver while watching the signal strength meter should help pinpoint the location of the bug. A receiver with a front-end sensitivity control (RF gain control) or input attenuator is handy to prevent receiver overload when you get very close to the transmitter (see Appendix C).

At this point, it pays to keep in mind what we discussed in the previous chapter concerning the most often used bands and commonly available equipment. The commercial FM broadcast band merits special attention, especially in domestic cases or any other situation where the bugger might tend to be less sophisticated than, say, in a major corporate case.

Many surveillance types realign their FM receiver to extend its coverage slightly above or below the normal band limits of 88-108 MHz. One should be particularly alert for signals from 82 MHz to 112 MHz. This is about as far as a commercial receiver can be detuned.

Another nasty trick eavesdroppers use is to hide their signal "on the shoulder" of a strong local FM station. This means they tune their transmitter as close as possible to a powerful commercial station, which makes it easier to miss when tuning across the band. It also makes it less likely to be noticed on a spectrum analyzer display, which we'll get to shortly.

The same theories apply in the business bands, from 150 to 170 MHz and 450 to about 470 MHz. On these bands the receiver should be set to the narrow-bandwidth mode because the signals are likely to be crystal controlled with very little frequency deviation.

An extremely crude surveillance methods involve buying a pair of citizen's band walkie-talkies and taping down the push-to-talk button on the one that's hidden at the site. It pays to check these CB channels located at and above 27 MHz. There's also some activity between 45 and 49 MHz, where a lot of commercially available remote-control equipment can be modified. The same is true up around 330 MHz (garage door openers, Medic-Alert, and so on).

There are also several amateur radio bands spread throughout the range we've been discussing, and equipment is readily available off the shelf. However, "hams" monitor their frequencies like hawks and the possibility of getting away with a clandestine transmission on one of their bands is highly unlikely. The one exception to this is the two-meter band from 142 to 149 MHz. This is by far the most popular ham band for short-range communication using pocket-size transceivers (transmitter/receiver combinations), and in a remote rural area with light amateur activity, a unit that is turned down in power to cover just a few hundred feet could easily go undetected.

These are just some of the more common frequencies used. One should diligently check every frequency from end to end of the receiver's range because a good operative will build or modify a transmitter to work on a frequency where activity would be least expected. Remember that an infestation can occur anywhere.

RF SNIFFERS

Although a successful RF sweep could be carried out with only the aforementioned equipment, there are several additional devices that greatly simplify the task. The most useful of these is undoubtedly the RF "sniffer." This is a handheld untuned receiver with a short whip antenna and a signal strength meter. Because there are no tuning circuits in the front end of the receiver, it simultaneously picks up all signals at any frequency within its bandwidth. Typical units operate from 100 kHz or so all the way up to a gigaHertz. The readout indicates the sum of the signal strengths of every signal received. Although at first glance this may seem like a useless idea, with all of the TV stations, FM stations, commercial transmissions, and so on in the air at the same time, the addition of a sensitivity control completely changes the picture.

In actual use, the sensitivity control is adjusted so that the combined signal strengths just start to deflect the readout upwards. Then, if the unit is moved closer to a transmitting bug, the readout moves upscale. The closer the bug, the higher the reading.

One of the characteristics of electromagnetic radiation is that the signal strength decreases relative to the square of the distance traveled. In other words, if you take a reading of signal strength at a given distance from the source, at twice that distance you get one fourth the reading, at three times the distance, you get one ninth the original level, and so on. This means that even if there's a 100,000-watt TV station a mile down the road, if you're one foot away from a one-watt bug, the signal from the bug will be considerably higher. This makes for a very useful bug detector. Being sensitive to virtually any frequency that a bug might be operating on, merely approaching the bug will cause an increasing readout. Some units use an audio tone that increases in pitch as signal strength increases and others use a bar graph display. Both will indicate the presence of a transmitter if brought close enough to the bug.

In practice, if the sensitivity is properly adjusted to just barely indicate the combined level of all the background signals, a noticeable increase in readout will occur when the unit is moved to a couple of feet away from the average power bug, and will increase dramatically as it is brought even closer.

In actual use, the device is passed over all wall surfaces, outlets, fixtures, and any other suspicious area. It essentially "sniffs" for the presence of radiation anywhere within its bandwidth. Needless to say, this can greatly speed up the sweep process. The units are quite small and inexpensive enough (in the $100 – $250 range) that each member of your team should have one. Commercial units have probes for infrared pickup, tape recorder oscillator circuits, and so on (see Appendix C). We also include circuit board layouts and construction details for a simple yet effective unit that you can build yourself.

OSCILLOSCOPES

Some transmitters, especially those wired into the AC line for their operating power, use that same AC line as an antenna. It's advisable and relatively easy to check for these with an oscilloscope, and it's best to use a battery-powered scope because of grounding and polarity considerations. (NonLinear Systems, B & K, and Tektronix all make small portable units.) Simply plug the probe into one side of the AC outlet and the ground lead into the other side and you should see a nice, clean sine wave. Check at various sweep speeds; if there is any signal riding on the 110-volt, 60-cycle AC wave, it will be easily seen (see Appendix D) This is also the best way to check for systems like wireless intercoms, which don't use the AC lines as an antenna but rather function as a wired carrier for the audio signal (these are known as carrier current devices). Oscilloscopes can also be handy for telephone line analysis, as we'll see later.

FREQUENCY COUNTERS

Another small, inexpensive, yet extremely useful piece of test gear is a frequency counter. Let's say that you've located a possible transmitting device during the physical search and you wish to monitor it. Instead of hunting all over the dial with your FM receiver to locate its frequency, you can employ a frequency counter to pinpoint its operating frequency within a few cycles per second.

These units are essentially event counters, which count the number of cycles of an AC wave over a preset time interval. They are usually crystal controlled and compute the frequency in terms of Hertz. They are usually equipped for surveillance work with a short whip antenna for pickup, and if within a few feet of the radiating source will display the frequency on a four- to eight-digit readout. Accuracy ranges from one part in 10 +6 to one part in 10 +9 for units with a temperature-controlled oven for the time-base crystal. This latter accuracy would give a readout accurate to one cycle at one GHz. There are also pre-scalers to extend the frequency coverage, and the relatively new development of active pre-selectors, which are extremely useful for countersurveillance work. See Appendix C for further information.

SPECTRUM ANALYZERS

One of the most highly regarded yet least understood pieces of test gear is the spectrum analyzer. In many sweepers' opinion, this is the ultimate diagnostic tool because having one automatically makes you an expert. Some operatives think the client will be impressed by the imposing array of knobs, dials, and readouts. Unfortunately, even among those fortunate enough to own one, very few know how to properly use it.

This device can monitor an entire band of frequencies simultaneously and display them in real time as a function of signal strength versus frequency. In its simplest format, this unit consists of three components: a tunable radio receiver, a sweep circuit that continuously and repetitively tunes the receiver from one end of the desired band to the other, and a display readout that shows relative signal strength and that is synchronized to the sweep circuitry. The display is typically an oscilloscope, which is a device with a cathode-ray tube (CRT) for a readout. An electron beam sweeps across its face from left to right and back to repeat at a rapid rate. Voltage applied to a vertical drive circuit deflects the beam upward from the baseline in an amount proportional to the magnitude of the voltage present.

If the vertical signal is derived from the output of the radio receiver and the receiver is tuned across a band of frequencies, every time a transmitted signal is received, the beam will deflect vertically, thus indicating the strength of the incoming signal.

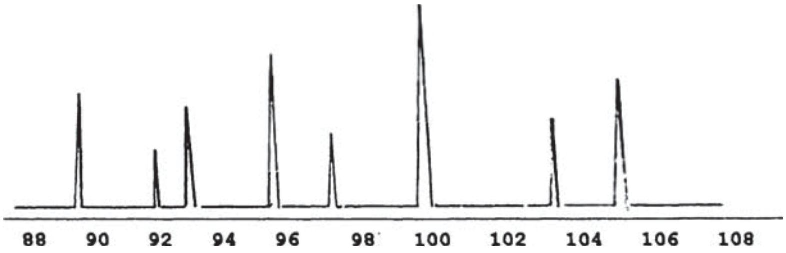
The remaining circuit to complete the analyzer is the sweep circuit, which automatically tunes the receiver and also drives the CRT beam horizontally at the same rate. The resulting display represents the band of frequencies being observed with the lowest frequency at the left edge of the CRT baseline, with the highest on the right. At each frequency with an active transmission present there will be a vertical line corresponding to the strength of the transmission.

Three basic adjustments control the operation of the analyzer: a center-frequency adjustment, which sets the middle of the display to a given frequency; a sweep width control, which sets how far above and below the center frequency will be displayed on the CRT; and a sweep rate, which determines how fast the beam and tuning control will traverse the range of frequencies.

If such a circuit were connected to an FM receiver with the center frequency set at 98 MHz and the sweep width set at 20 MHz (from 10 MHz below center to 10 MHz above), the display would show the entire commercial FM broadcast band and indicate all active FM stations in the area simultaneously. It might look something like this.

All types of modulation formats are visible and the vertical scale can be calibrated to indicate relative signal strength.

If the sweep width is set very wide, the entire spectrum—from a few MHz to several hundred MHz—is displayed. As the width is decreased, the "window" looks at smaller and smaller segments of the spectrum. At the narrow end, a single transmission can be spread out across the entire width of the display. Looking at a TV station transmission in this manner reveals the picture carrier, the sound sub-carrier, and any additional sub-carriers individually.



Pips.

Obviously, such a device would greatly simplify the task of searching for hidden transmitters. Even though they are usually quite low in power, if they are transmitting from a relatively close location their signal strength would be quite high relative to a distant commercial station.

Keep in mind, however, that the vertical line or "pip" produced by a surveillance transmitter will appear identical to a commercial station. Because the transmission is probably a frequency modulation mode, the height of the pip will not change with modulation. However, if you move about the room, a pip generated by a bug will change in height as you approach or recede from the location. The line from a commercial station a few miles away will not be affected by the slight change in relative distance if you move 10 feet farther away, but moving 10 feet closer to a bug that is 20 feet away will result in a noticeable increase in the amplitude of the marker.

Most analyzers have a manual tuning mode that disables the sweep circuitry and allows one to tune the unit like a standard receiver, this so that each pip may be tuned to center screen and listened to individually. Theoretically, you could investigate each pip to determine if it was a legitimate transmission, but then a standard communications receiver would suffice and the utility of the analyzer is lost.

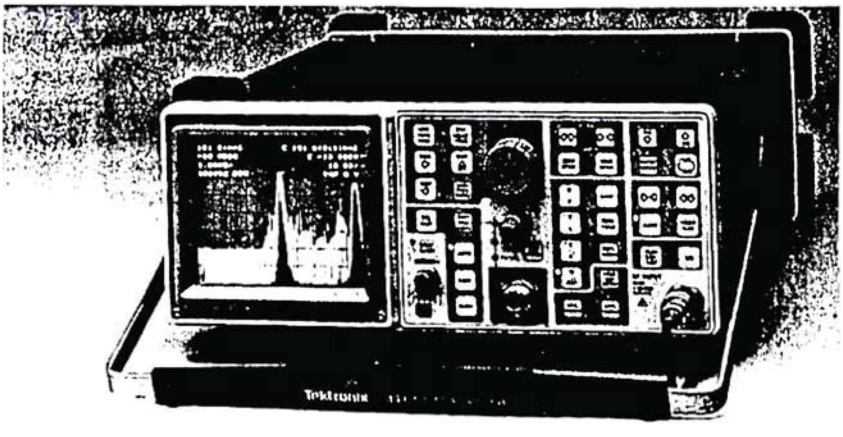
One option available on the more expensive models of analyzers is a memory mode. This effectively stores a copy of whatever is appearing on the screen in a memory bank for later retrieval. There's a neat trick that can be used with this arrangement for bands of frequencies like the FM broadcast band. At a location remote from the search site (which you know to be free of bogus transmissions), a memory reading is taken of the entire band. This memory map can then be inverted, that is, the pips would now go below the base line, an exact upside-down copy of the original. This can then be algebraically added to a new readout of the same band and all the constant signals would be canceled out, resulting in a straight baseline with no pips. An inverted map is obtained at a clean location and is then added to the readout at the target site. If there is a spurious transmission at the site, then everything will be canceled out except for the bogus transmission, which will be the only marker visible. This works on bands like the commercial broadcast bands (where transmissions are constant) but is useless for bands like the business band, where signals are sporadic.

If you consistently do sweeps in the same geographical area, you soon start to recognize the legitimate transmissions and their relative amplitudes and acquire an ability to recognize suspicious markers.

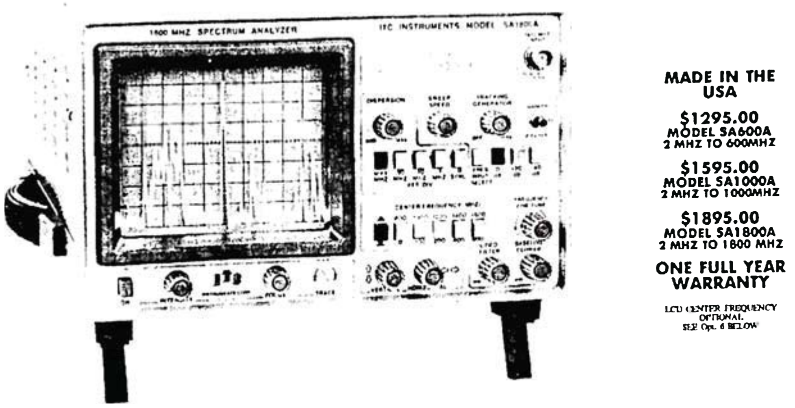
Another use for spectrum analyzers involves the relatively new method of signal transmission known as frequency hopping. This is a technique whereby the transmitted signal is sent for a brief period (typically fractions of a second) on one frequency, then switched for another brief period to another frequency, and so on. The receiver has an identical list of frequencies stored in its memory and switches in synchronization with the transmitter so that it is always on the correct frequency to hear the transmitter. With the advent of frequency-synthesized local oscillators and scanner–receivers with 100-channel memory tuning, this has become quite easy to implement.

This is a very difficult type of transmission to pinpoint because the signal never stays put on a fixed frequency long enough to zero in on. With an analyzer, however, it will be quite apparent. There will be a pip that appears to jump all over the readout in a random manner. After a number of jumps the pattern will repeat itself. As many as 16 different frequencies are typically used before the sequence repeats.

Another clever method of transmitting information to avoid detection is called "burst" transmission. In this case, signals received at the target site are stored in some form of memory and then transmitted all at once. The storage device works like a voice-operated tape deck in that all dead time between actual conversations is eliminated so that a steady, condensed stream of data is available for transmission whenever needed.



The Tektronix 2710 spectrum analyzer.



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ITC's 1800 MHz spectrum analyzer.

These transmissions can be triggered by a preset timer, usually at a time when monitoring by sweepers would be least likely or it may be triggered via remote control from a listening post. For example, a room pick-up mike feeding a memory unit and transmitter would store all conversations for, say, 24 hours, eliminating all dead time in between. If this arrangement were connected to a radio-controlled activator, an operative could drive by the target site at 4:00 AM and trigger the affair. It would dump all the data via its transmitter and then go back to the off-the-air data-gathering mode until triggered again. One clever arrangement we've heard of uses the new AT&T digital telephone answering machine, which has fantastic memory capability, is quite small, and can apparently be easily modified.

It should be noted that spectrum analyzers are not inexpensive, with commercial models ranging from $3,000 to more than $10,000. Some of the more popular models are listed in the appendices. There are also kits available for considerably less for those willing to do a bit of home-brew construction. [1]

SUBCARRIER TRANSMISSION

Another sophisticated technique used by the surveillance operative is subcarrier transmission or FM/FM modulation. This involves using the audio information to frequency modulate a relatively low-frequency carrier, usually below 100 kHz. This carrier is in turn used to modulate a higher frequency carrier on the desired operating frequency. The lower frequency carrier is then referred to as the "subcarrier." This method is commonly used by commercial FM stations to transmit background music for businesses and offices along with their standard broadcast programming. It requires a separate decoder or demodulator to be attached to the output of the receiver's main demodulator section. Anyone tuning in the main carrier cannot hear the subcarrier transmissions. The advantage of this process for surveillance use is obvious and detection is almost impossible without knowing the subcarrier frequency. A spectrum analyzer will show all subcarriers, however, and once located, they can be analyzed by standard techniques.

See the appendices for specialized units that detect and identify subcarrier transmissions. There are also construction plans for a subcarrier tuner.

AUTOMATED SWEEPS

Another countersurveillance technique that's gaining popularity involves automated sweeps. This involves creating a sound in the target room that is coded or otherwise unique, which can be recognized by a decoding device attached to the receiver. The receiver is tuned, or scans, the RF spectrum from end to end in much the same fashion as a spectrum analyzer and tries to find a transmission of this coded signal. When the high end of the band is reached, the process repeats itself. If a match is found, the time and frequency of the transmission is recorded and the search continues. This permits full-time, unattended monitoring of a site. One currently available unit [2] uses a series of three touch-tone signals identical to the dial tones used in telephone systems and plays these in a repeating pattern through a small amplifier and speaker in the target room. A touch-tone decoder attached to the receiver looks for a transmission of these same tones from a hidden bug as the receiver slowly scans the band. When a match is found, an attached cassette deck records the time and frequency. This is a handy way of continuously checking for the presence of bugs, especially duplex or timer-activated systems that may not be active full time.

RADIO DIRECTION FINDERS

One last piece of test gear that's useful, especially in large areas or buildings is the radio direction finder, or RDF. If you're sweeping a relatively small office or conference room and you detect a spurious transmission, it's generally fairly easy to pinpoint the location of the source. Let's say, however, that you're in a large, open space, such as a secretarial bullpen, where there are numerous cubicles divided by short wall partitions, and you spot a transmission whose source you wish to locate. Sweeping all the surfaces with a sniffer can be very tedious, and there's always the possibility you might miss the site by just enough to fail to get a noticeable reading on the sniffer. A device that can show the direction the signal is coming from would be ideal and would allow you to easily zero in on the transmitter.

Enter the RDF. Most of these units use an FM receiver that covers the bands of interest and some form of Doppler signal processor. The Doppler effect is what you notice when you hear, for example, a train go by. As the train approaches, the tone of its whistle is a constant pitch. As soon as it passes you and starts to recede, the pitch drops noticeably. When it's coming at you, the speed of the train is added to the speed of the sound wave, increasing its apparent frequency; as the train moves away, its speed is subtracted from the whistle's pitch and the tone appears to lower in frequency.

As employed in an RDF unit, the Doppler processor depends on a pair of antennas, usually short, vertical whips, separated by a few feet and mounted on a hand-held crossbar. This array is connected to the processor and then to an FM receiver, which is tuned to the frequency of the transmission in question. The processor switches its input rapidly back and forth between the two antennas. As you rotate the antenna array, one of the antennas will be closer to the transmission source than the other and there will be a phase difference between the two received signals. The output of the processorñreceiver combination is connected to a readout device, usually a zero-center meter or LED display. When the line through the two antennas (i.e., the crossbar) is exactly perpendicular to the incoming wave, both antennas will be equidistant-distant from the source and the meter will read zero, or the middle of its range. Moving the array clockwise or counter-clockwise will bring one antenna closer to the source than the other, and the readout will deflect left or right to indicate this deviation. This allows you to point the array directly at the source of the transmission. Most units also contain a signal-strength meter to give relative distance indications (see Appendix D).

This method is routinely used for tracking vehicles. A transmitter is secreted on the target vehicle and the RDF is mounted in the chase car, which allows the target vehicle to be tracked or located from several miles away. Vehicle-tracking RDF systems are covered in some depth in issues 23 and 24 of *Full Disclosure* [3] and there are several excellent books on radio direction finding available. [4] We also include in the appendices plans for an antenna array-processor unit that you can build and attach to your FM receiver to make a very functional, portable RDF system.

VIDEO TRANSMITTERS

A few final words here about video transmitters are in order. Over the past few years, equipment has become available permitting real-time transmission of video and audio from a small camera. Much of the developmental work in this area was done by amateur radio operators and assumed the acronym ATV for amateur television. This is a recent enough development that there are no clear-cut federal regulations in place (yet) and the legality issues involved in watching someone covertly are quite hazy. There is a proliferation of equipment and kits for small video transmission systems available for use by licensed hams and, needless to say, some of this technology has found its way into the surveillance field.

One factor to bear in mind is the bandwidth requirements. A typical video signal, with all its various timing, sync, and picture elements, takes up about 8 MHz of bandwidth. Because of the crowded nature and limited spectrum of the VHF ham bands, most ATV units operate on UHF bands at 430 MHz, 902 MHz, or 1.2 GHz. This also permits small antennas and compact transmitter design. Essentially, these are complete TV transmitting stations, identical to their higher-powered commercial counterparts.

From a covert surveillance operator's viewpoint, there are pros and cons to each band. The 430 MHz band is just below the lowest UHF TV channel, and because most TV receivers have manual tuning that extends slightly past the commercial band edge limits, a unit operating at, say, 438 MHz can usually be tuned directly in on a monitor TV. Unfortunately, anyone else within range hunting around at the low end of the dial can also see the picture.

The band from 902 to 928 MHz is probably the most popular. There's activity on the 1.2 GHz band as well, but the higher we go in frequency, the more we have the usual problems associated with microwaves (extremely limited bandwidth allocation, adverse atmospheric effects, line-of-sight requirement, and so on).

There's another reason the 902 MHz band is attractive. The FCC recently approved public use of the band under Part 15 of federal regulations, which covers devices intended for very-short-range transmissions. You can now purchase, over-the-counter and with no license, video transmitters designed to attach to your video cassette recorder, for example, that will transmit that signal to other rooms of the house, allowing you to watch tapes from the VCR on another TV located elsewhere without having to run interconnecting cables. These transmitters are limited by law to a certain maximum effective radiated power, which limits their useful range to about 120 feet. However, by modifying these units for battery operation, a useful short-range surveillance system results. One-hundred and twenty feet is often more than enough for covert monitoring, and the span of 902 to 928 MHz allows three 8-MHz-wide channels to transmit simultaneously.

Because this band is above the UHF TV channels, a converter between the receiving antenna and TV monitor is necessary. This takes the incoming signal—at 910 MHz, for example—and converts it down to the 50-70 MHz region so that it may be tuned in with a standard TV on channel 2, 3, or 4. This has the added advantage of security; no one without a converter can accidentally tune across the transmission.

It is also fairly easy to add booster amps or gain blocks to the output of the transmitter to increase its range, which is illegal but quite commonplace. A converter unit should be a standard item in your tool kit, and both the 430 and 902 MHz bands should be checked if there is any suspicion of video monitoring.

INFRARED AND OPTICAL SYSTEMS

Before we finish this chapter, a few words about infrared and optical systems are in order. IR systems may be short-range, omnidirectional-directional affairs designed to transmit information through a window or doorway to a receiving/recording unit, or they may be optically focused arrays designed for ranges in the hundreds to thousands of feet. In both cases, standard RF sweep techniques are useless and special procedures need be employed.

Short-range arrays are typically a two-unit package that in many cases are modified versions of commercially available devices. A good example would be Radio Shack's wireless headset and transmitter (model 32-2050), which was originally intended to attach to your stereo and send the audio signal throughout the room on a modulated IR light beam. The headphones have an internally mounted IR receiver, and anywhere within the IR field they will intercept the light beam and convert it back to audio. The effective range is only 20 feet, but the devices are compact and may be adapted for battery operation. In practice, the microphone, a suitable mike preamplifier, and the IR transmitter are placed in the target site and the receiver/recorder combination is mounted on the opposite side of a common window or open doorway. One simple yet effective system we ran across had the microphone/transmitter combination mounted in a smoked-glass vase, which was placed on the table in a conference room. Any container that is optically transparent to infrared will work. The receiver/tape recorder was on the opposite side of a common window on a secretary's desk. This is a very discrete, easily deployed system that defeats detection by normal methods.

There are also focused systems that use lenses to concentrate the transmitted signal into a narrow beam, which gives you vastly extended ranges. Several electronics hobby magazines have recently carried construction articles on focused IR systems.

There are several methods available to detect IR radiation. The simplest involves a small card that is sensitive to IR. These cards fluoresce or emit a visible light output when in the presence of IR signals. They must be in very close proximity to the source but they're cheap and effective. They're also a handy way of checking PIRs (passive IR) burglar alarm sensors for an output. Again, Radio Shack has a suitable model (276-099 for about $5.95). They will also detect some forms of laser transmissions.

One expensive yet effective method of IR detection involves night-vision goggles (NVGs), which are usually surplus items. These goggles make all forms of IR radiation visible, usually in shades of green. They are quite handy for evaluating alarm systems that employ PIRs as well.

It should be noted that video cameras or recorders equipped with infrared lenses (or other night vision equipment) will also detect IR radiation.

In the appendices we include plans for a small, battery-operated unit that picks up IR radiation from fair distances and gives a visual readout that indicates the direction of the incoming signal.

Laser systems are much more difficult to detect because you must be directly in the beam's path and have a receiver/detector tuned to the exact frequency of the transmitting laser. In Appendix C we list sources for laser transmitters and receivers.

The best protection against laser intrusion is the employment of preventative measures. Heavy drapes over any exterior windows will effectively defeat most systems. This falls under the area of client education, which should be a part of any sweep procedure. Thermopane or triple-glazed windows also minimize laser pick-up systems.

• • •

In summary, to be a successful, professional countersurveillance technician, you need to know the frequencies and methods of transmission most likely to be employed by the other side. New technologies are emerging almost daily and it's important to keep up with progress in these fields.

There are certain tools and test devices that are imperative for a successful sweep and other items that, with the proper training and application, will greatly simplify your task. Even the most sophisticated equipment is useless, however, if you do not have a concise, organized method of employing them.

ENDNOTES

1. Printed circuit boards and parts kits for an inexpensive spectrum analyzer that can be added to any standard oscilloscope are available from Science Workshop, Box 310, Bethpage, New York 11714. A complete set of boards and parts, less cabinet and external controls, is in the $100 range. These are excellent kits that produce a finished product that will do almost everything its bigger brothers can do. Murray Barlowe, who runs Science Workshop, is also coming out with a book on spectrum analyzers soon that promises to be well worth reading.

2. Auto-Sweep, made by ECO-TEC, 1187 Waukechon St., Suite 9, Shawano, Wisc. 54166

3. Lieg, Peter. "Vehicle Tracking Systems: The Technical Side." *Full Disclosure* issues 23 and 24.

4. Moell, Joseph D. and Thomas N. Curlee. *Transmitter Hunting: Radio Direction Finding Simplified.* Blue Ridge Summit, PA: TAB Books, 1987. Aimed at the amateur radio operator, this is a very thorough treatment of radio direction finding that is quite useful for the countersurveillance technician.

Telephone Systems

By far, the most pervasive (some would say intrusive) piece of electronic technology is the telephone. There are more than 100 million telephones in the United States alone and any one of them may be interconnected with any other one by an unskilled operator simply by pressing the right sequence of numbered buttons.

Invented by Alexander Graham Bell in 1876, the rights to the invention have, until quite recently, been the property of AT&T. Whatever your feelings on monopolies, this arrangement allowed the construction of the support medium necessary to make the telephone system a viable means of communication. By itself, the telephone is quite useless, but attached to a far-flung network of cabling, reaching virtually every corner of the world, the phone system permits almost instantaneous communication between any two people on the face of the earth.

It is this network of interconnecting wiring and the attendant switching stations that give the phone system its fantastic capabilities—and also its greatest potential for abuse. Any signal traveling down a pair of wires may be intercepted simply by tapping across those wires at any point between the two communicating parties.

To appreciate how easy this interception can be and to learn how to detect it when it is happening, a basic understanding of how the system functions is necessary.

When you lift the handset to place a call, the telephone alerts the switching exchange that a call is about to be made and lets you know the exchange is ready by emitting a dial tone. After you dial the number desired, the various interconnections are made and it indicates whether the call can be completed by either a ringing tone or a busy signal. It then rings a bell at the called party location to indicate the presence of an incoming call and makes the necessary connections. It breaks the connection when the handset is replaced on the telephone set.

While the call is in progress, the electronic signals representing your voice are sent down a pair of wires through various substations to a central exchange. They are then routed out through other substations to the called location. Signals between substations and the main exchange may be sent by microwave or even the relatively new method of fiber optics, which uses light pulses traveling down a "light pipe" or transparent fiber cable. In both cases, multiple calls can be transmitted simultaneously using multiplexing or time-sharing techniques. However, from the calling phone to the first substation, and from the last substation to the called party, only a single call exists on the wires at any given time. This is where taps can be made.

As we've pointed out before, "bugging" a phone refers to attaching a radio frequency transmitter to the phone lines, and sweeping is treated much the same as sweeping for a room-monitoring transmitter. "Tapping" a phone refers to intercepting the signal by means of a hard-wired connection from any point on the lines to a recording or monitoring location. We will be primarily concerned with phone taps in the following chapters, although most of the techniques used to indicate the presence of a tap on the lines will also show the insertion of a bugging transmitter within the system.

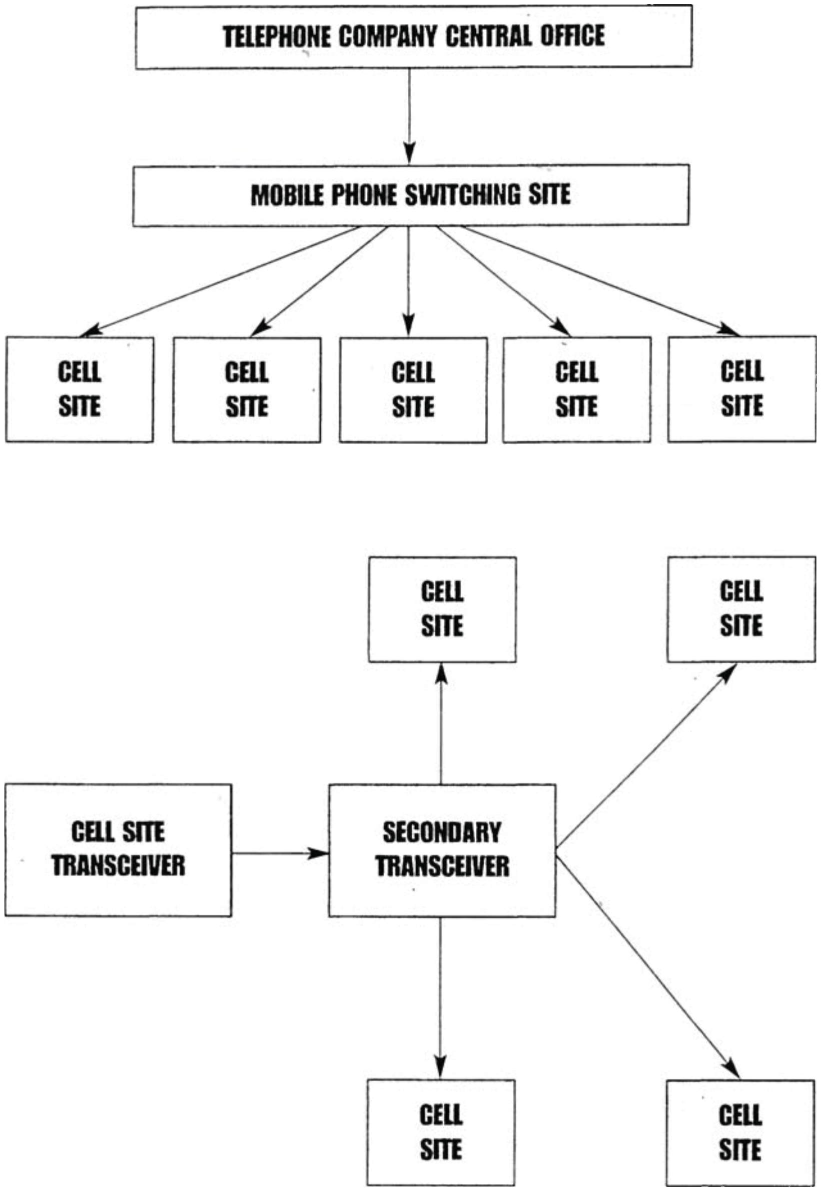
CELLULAR SYSTEMS

There has been a recent marriage between telephone technology and radio frequency electronics, first with the cordless phone and later with cellular phone networks. In both cases, some or all of the hard-wired network is replaced with a radio frequency transmitter link. Upcoming developments in direct-to-satellite calls are extensions of this technology.

In the case of cellular or portable phones, the signal from the calling phone is transmitted on a radio wave at approximately 800 MHz and is picked up by a nearby repeater transceiver. Tower-mounted and spaced at intervals over large areas of the country, these repeaters pick up the 800 MHz signal and translate it to a higher frequency somewhere in the microwave range. It is then beamed in a line-of-sight transmission to the next repeater and so on, leap-frogging through the network until it reaches the repeater nearest the called party, where it is sent out in the original 800 MHz band for reception by the called phone.

At either end of this link, the signal exists in the air as a normal voice RF transmission, and both sides of the conversation may be intercepted by anyone with a radio receiver tuned to the correct frequency.

Listening to these conversations covertly is illegal, but there is virtually no way this practice can be detected short of catching the perpetrator in the act. Law enforcement agencies routinely monitor these frequencies as well. There is a story circulating about a dealer who set up a major drug buy using



The telephone company's basic system.

his cellular phone, hung up, and then placed a call ordering a pizza and giving his home address. The DEA showed up before the pizza did. Needless to say, this is a very insecure line of communication and your clients should be so informed if they aren't alert to the fact already. Absolutely no confidential information should be discussed on cordless or cellular phones as there is virtually no way of knowing who might be eavesdropping on the transmissions.

FAX AND COMPUTER LINKS

There are two other relatively recent blends of telephone and electronic disciplines that should be of concern to the countersurveillance technician. The first of these involves computers and modems (modulator/demodulator). A modem takes input and output information from a computer at location A and converts it to tones that can be transmitted via the phone lines to a computer at location B. This permits two computers to interlink and exchange information, or permits a smaller computer to tie into the memory bank and data-processing circuitry of a larger, central mainframe computer. Obviously, much information sent in this fashion is confidential in nature, but coding schemes are rarely used, so unauthorized interception by a third party is a distinct possibility.

Another even more prevalent use of the phone lines involves sending copies of documents with a fax machine. Similar to having a Xerox machine hooked up to both ends of a phone connection, the data again is sent as a series of tones, which are converted back into characters at the receiving end and printed onto paper. Again, at any point on the transmission path, another fax machine may be inserted surreptitiously and the entire transmission may be copied.

The important factor here is that no additional connections need be made to the computer or the fax machine. If there is a tap in place on the phone line, whatever information is present on the line is compromised.

One advantage for the surveillance operator when tapping or bugging phone systems is the presence of a voltage across the lines whether the phone is in use or not. This eliminates the need for batteries or a connection to an AC source for power. There are typically four wires entering a site for telephone connection: red, green, yellow, and black. Only the red (the "ring" connection) and green (the "tip" connection) usually need to be attached for proper operation of the system. (The terms derive from the one-quarter-inch phone plugs used to make connections in old-time, manual exchange switchboards. In some older phone systems, the yellow wire must be tied to the green, which is normally done internally.)

When the phone is on-hook, 48 volts exist across the red and green wires. This drops to about five volts when off-hook. Even five volts are more than enough to power a transmitter bug or a line-transmitting unit. In addition, because this voltage is supplied by the phone company on its own wires, it is in no way dependent on local 110-volt AC power. Even in the event of a power blackout due to storm or emergency, the phone system usually continues to function. The phone company also thoughtfully provides lightning protectors at the cable entrance, which will also protect surveillance gear placed down-line from them.

BUGS

First, let's deal with RF transmitting bugs. As we've previously discussed, these can usually be located by standard RF sweep techniques. The problem is that many of these transmitters are dormant (inoperative) unless the phone is off-hook and a call is in progress. This can be overcome by placing a call on the phone in question. Dial your office answering machine, the time-and-temperature report, or any other number you know will be answered so that a completed connection may be established, and then sweep for RF transmissions in the usual fashion.

However, most of the procedures employed to locate a hard-wired tap will also reveal the presence of an RF bug, dormant or not. Connection methods fall into four categories: "leech" transmitters (both series and parallel, plus a battery-operated unit connected in parallel) and induction pick-ups, which typically require no operating power.

Leech transmitters are those that obtain their operating power from the voltage present on the phone lines, typically five volts in the off-hook mode. A series-connected unit is spliced in-line with one of the wires, usually the red. A parallel-connected leech unit is bridged across both wires. If proper impedance (AC resistance) levels are observed, both of these are difficult to detect.

There is, however, a limited amount of power that can be leeched from the phone lines before the apparent impedance changes noticeably or the five volts starts to drop or rise. In reality, these amount to the same thing. If an extended transmitting range is required, a battery power supply must be used to prevent unacceptable loading on the phone's power system. These battery-operated units are usually wired in a parallel configuration.

Induction pick-ups overcome these problems because they have no direct connection to any of the phone wiring and therefore present no loading whatsoever. They are also quick and easy to install. Functionally, the pick-up is a small, multi-turn coil of wire, often equipped with a suction cup for easy external attachment (although covert surveillance usually dictates placing the pick-up inside the phone handset or housing), which is installed close enough to the large inductors (coils) present inside the phone to intercept part of the magnetic field produced by these inductors. This field induces a voltage in the pick-up coil that is an exact duplicate of the signals on the phone lines. From there it goes to a transmitter input (in the case of a bug) or is hard-wired to a recording or monitoring station (in the case of a tap). These hook-ups usually include a 60 Hz notch filter to remove any hum pickup from adjacent power wiring.

BUG ZAPPING

There are several methods used to locate or disable bugs and taps. Besides RE sweeping for bugs and physical inspections, both of which we've covered, some technicians use the shotgun approach. This involves sending a very-high-voltage—usually several thousand volts—pulse down the phone lines, which effectively zaps any bugs or recording devices connected to the lines. Of course, the phone must be disconnected first, and the lines must also be disconnected from the incoming service feed to prevent destroying equipment at the substation or exchange. Induction pickups are occasionally immune to these tactics and spike protectors can be built into the bugs or recorders to damp out these high-voltage spikes. They work most of the time.

VOLTAGE–IMPEDANCE MEASUREMENTS

Besides the approaches mentioned above, there are two broad categories of test techniques used to indicate anomalies on the phone lines. The first one involves devices that measure the impedance and off-hook voltage of the lines, looking for deviations from normal. The problem is, a properly designed and installed bug can be almost invisible to these methods.

TIME DOMAIN REFLECTOMETRY

Time domain reflectometry (TDR) is a sophisticated (and expensive) method of analyzing the physical condition of phone lines. Under the proper set of preconditions, its use can indicate changes from the last reading with great accuracy. It can also indicate the distance from the measurement point at which the discontinuity exists. In the next chapter, we'll cover all these approaches and discuss currently available diagnostic equipment.

• • •

If the phones at your target site are being monitored by law enforcement groups or a federal agency, chances are you'll never know. But even they have to get a court order under Title 3 (see Appendix A) if they wish to use the evidence in court. They generally have the cooperation of the phone companies and the tapping can be done way down the line at one of the exchanges, where it will never show up on your tests.

The best advice to your clients is to send absolutely nothing of a sensitive nature over a phone that you have any reason whatsoever to suspect is compromised.

Telephone Line Analysis

As is the case with RF sweeping, phone line analysis is most successful when a standardized, routine procedure is followed. The first step is the physical inspection, which is usually much more straightforward than an inspection for room monitoring transmitters because any taps or bugs must be attached to the phone or its incoming wires. Disassemble and inspect the telephone set first, looking for any foreign objects or connections inside. Repetition breeds familiarity and you should soon be able to instantly recognize anything unusual.

PHYSICAL CHECKS

The next step involves following the wires backwards from the phone as far as possible, hopefully all the way to the service entrance to the premises. This is the point where the wires from the telephone pole enter. In many cases, from this point upstream (toward the central exchange) the wires are either high off the ground, as in an aerial feed, or buried underground. If there is a pedestal termination block (these are often green fiberglass boxes several inches square and several feet high where all the individual feeds for a given area converge for connection to a multiple conductor feed from the phone company) inspect the lock for damage or tampering (taps or bugs can easily be installed here). From this point upstream, it is unlikely there would be any compromised wiring.

If you can physically trace each line back to this point without finding any covert connections, you can be reasonably certain the line is clean. All extension phone lines should be traced back to their common interconnect points and multiline phones should have each line checked individually.

VOLTAGE AND IMPEDANCE CHECKS

In many cases it is difficult, if not impossible, to check every inch of every line, especially in business offices with many lines and extensions or in buildings with wiring enclosed in walls. Even if you think the lines are physically clean, a voltage and impedance check should be performed.

Most of the commonly available bug-and-tap detectors are designed to indicate anomalies in these two parameters. As we've said, the normal voltage between the red and green wires on a phone feed should be about 48 volts when all phones are on-hook, and drop to five volts or so when they are off-hook. If there is, for example, a series connection for a bug and you measure the voltage upstream of the connection, there will be a five-volt drop across the phone and another drop across the bug. The apparent voltage measured upstream will be the sum of these drops, which is usually only slightly higher than five volts.

If there is a parallel connection for a bug or a tap, additional current will flow through the tap and the apparent voltage will be less than five volts. These measurements must be carried out with the phone lines connected because they supply the operating voltage. The best procedure is to first make sure the phone is clean; substitute one of your own that you know is OK if in doubt. Take a reading at the phone with the receiver off-hook and then repeat the reading as far upstream as you can get; the readings should be the same and both should be very close to five volts. In Appendix B we've explained how to take a simple device with a modular plug input and output that can easily be inserted at these points to take a reading. It's basically a Y connector with a built-in voltmeter connected across the line. In both cases, the on-hook voltages should also be identical (close to 48 volts).

At this point, one disconnects either or both leads (red and green) at the service entrance and measures the resistance at both the phone end and service entrance end of the line(s). A normal resistance reading is more difficult to specify because of differences in phone designs, but the readings should be essentially equal. The reading at the service entrance end may be slightly higher due to the resistance of the additional wiring, but this should be on the order of a couple of ohms or less. Anything higher indicates a series tap and anything lower than the phone-end reading indicates a parallel connection.

Most designers try to keep the resistance of a series-inserted bug as low as possible to prevent appreciable voltage drop across it, whereas the goal for a parallel connection is extremely high resistance (to prevent loading down the line and pulling down the voltage). If properly designed, they are difficult to detect with either measurement method. The readings should be taken, however, because a surprisingly high percentage of bugs and taps are not properly designed.

TIME DOMAIN REFLECTOMETRY CHECKS

The only truly foolproof method of detecting a connection somewhere on the line (series or parallel) involves the use of TDR techniques. In simple terms, a TDR unit sends a pulsed signal down the cable and looks for reflected signals bouncing back up the line. At any point where there is a discontinuity in the normal impedance of the cable, a portion of the pulsed signal will be reflected back toward the source. By measuring the time it takes for this return pulse to appear and by knowing the propagation speed of the signal down and back up different types of cabling, a distance reading can be computed to tell the operator how far down the wire the discontinuity exists. Used extensively by cable TV companies to locate breaks and bad stretches of coax, the system is effective for distances of many thousands of feet and is extremely accurate and sensitive.

Unfortunately, it is also extremely expensive, test gear being in the several thousand dollar range. If you plan on doing a considerable amount of phone system analysis, however, this device will pay for itself in short order.

The one major limitation with this procedure is the necessity for a measurement of the same system that is under test when it is in a known "clean" condition. This is called a "signature signal" and is used for comparison against the signal received when the line is being tested for compromised conditions. It is vital to know the line is clean when doing the signature analysis; if a bug or tap is present at this point, the signature will be contaminated and future readings are meaningless. Anyone telling you the system will detect bugs without first having a signature of the same system when it is known to be clean is outright lying.

Because of this, this method is most useful for repeat analyses of systems, such as you would have in a service contract situation, where you might routinely and periodically check the same lines on a continuing basis. Any change from the original clean signature would indicate something had changed radically since the last check.

VOX RECORDERS AND PEN REGISTERS

There are a couple of devices that are normally hardwired (tapped) into phone lines at the site. The first category involves voice-operated audio tape recorders (VOX tape recorders). Telecorder and others manufacture recorders that attach to a modular jack present well-balanced, virtually undetectable loads to the line; and record all outgoing and incoming calls automatically. A suitable line interface circuit and a standard VOX tape recorder will accomplish the same thing. Normally, only a physical inspection will reveal their location.

Pen registers are connected in similar fashion and present the same detection difficulties. These devices record the dialed number, date and time of all out-going calls. A combination unit [1] records number, date and time of outgoing calls; and date, time, and both sides of the conversation for both outgoing and incoming calls. Again, a physical inspection is the best detection method.

• • •

Remember that a physical inspection is the best method for finding taps and bugs on phone lines. The phones themselves, every inch of accessible cabling, and the service entrance should all be inspected. Voltage and impedance checks will reveal careless installations and poorly designed taps and bugs, but a TDR test with a suitable signature signal for reference is the best technique.

Above all, customer education as to the insecure nature of telephone communication is the ultimate preventative measure. Current customers should be told that if they suspect phone line tampering and wish to contact you for a sweep, to use a pay phone or other unit known to be clean.

ENDNOTES

1. Available from Eco-Tec, 1187 Waukechon St., Suite 9, Shawano, WI 54166

Intrusion Alarm Electronic Countermeasures

In this chapter we'll outline two additional services you may wish to offer your client. While neither is necessary for completion of a successful sweep, both will prevent headaches for you and your client.

Evaluation of intrusion alarms is rarely done. In many cases the client had such systems installed merely to get a cut in his insurance premiums. Unfortunately, as an industry, the alarm installation business is no better than the countersurveillance business in terms of ignorance and incompetence.

PIRs, field sensors, sound-activated systems, photoelectric eyes, hard-wired perimeter networks, sirens, and automatic phone dialers are intermixed in many system designs with little thought as to their ultimate effectiveness. Many of the people who understand these systems best are not installing them, but rather defeating them for criminal purposes.

A complete vetting of a premises should include a comprehensive evaluation of all alarm systems. Because a good countersurveillance technician must learn to think like an operative from the other side, who better than you to do this evaluation?

An intrusion alarm usually consists of a central control panel, power supply, entrance deactivation system, and warning device. This assembly is connected to a series of sensors that detect movement or tampering. The central control panel monitors the status of all sensors and triggers the warning device whenever a sensor is activated. The warning device may be a siren or an automatic telephone dialer, which alerts the owner, the authorities, or a central monitoring service. Some systems employ closed-circuit TV (CCTV) cameras connected to a monitoring station or to a VCR tape machine. Smoke detectors may be included to alert one to the possibility of fire at the site. The central control supplies power for the sensors and usually has a back-up battery supply to permit operation in the event AC power is interrupted and has a defeat mode to allow entrance by authorized parties. This defeat mode may be accessed via a key switch at an outside entrance, a keypad similar to an electronic combination lock, a card-access ("cardex") system, or a delay circuit, the latter of which allows a certain time period to pass before activation of the warning device, thus permitting the owner to enter and deactivate the system.

The two most common forms of pick-up are field (motion) sensors and perimeter devices, such as magnetic door switches and window breakage sensors. Field sensors are usually PIR devices, which are circuits that flood an area with an IR light field—which is invisible to the naked eye, you'll recall—and look for reflected signals or disturbances of the field caused by an object or person in motion within the field. Some will also respond to body heat. Sound-activated sensors are also occasionally employed.

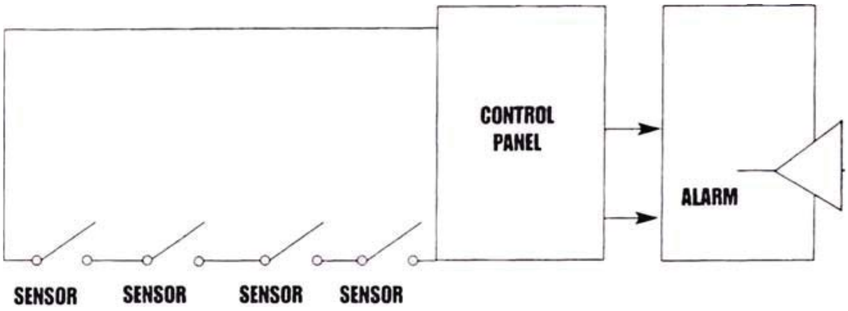
Perimeter devices are usually door switches (which may be mechanical or magnetic), conductive tape patterns on windows, breakage or vibration pickups for windows, pressure and mat switches triggered by someone walking on them, and photoelectric beams to protect a long expanse of wall surface or entrance areas. These sensors may be wired in a series configuration, which uses normally closed pickups so that any one of them opening will cause current in the series loop to be interrupted, thereby triggering the control unit and warning device(s). They may also be wired in parallel, usually dictating normally open sensors; any closure trips the main control.

Series-connected circuits, although occasionally more difficult to wire, provide the added protection of total loop security. This means anyone cutting the interconnecting wire at any point sets off the alarm. To deactivate a sensor on a door, let's say, it would be necessary to first install a bypass wire across the sensor and then clip the sensor lead inside the shunt. Parallel-connected sensors can usually be clipped off without effect, but they typically cannot be shunted. Field sensors are much more difficult to bypass, but are usually restricted to coverage of interior areas.

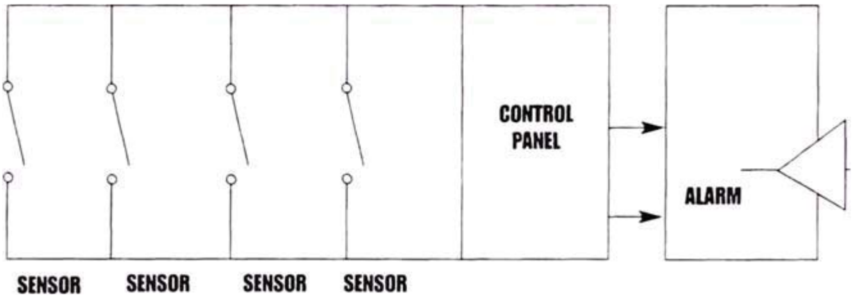
The best approach is to start with a floor plan of the area being analyzed. Mark all protected entrances and windows on the blueprint. Each door and window sensor should be checked for proper operation. Using an IR monitoring device, check the operation and area of coverage of all PIRs and field sensors and shade in these areas on the floor plan. PIRs can also be checked by slowly moving about in the general area and noting how far away the device can detect motion.

After you have all covered areas marked or shaded in on the floor plan, vulnerable areas will be obvious. Don't overlook possible entrance points such as skylights, garage doors, large ventilation ducts, flimsy Sheetrock partitions between your area and an unprotected adjacent one, and open spaces above drop ceilings common to other unprotected rooms.

If you note glaring omissions in the coverage pattern, additional sensors can be added. If the added sensors are needed in an area quite remote from the control panel, RF



The series alarm system.



The parallel alarm system.

transmitter-linked devices may be employed to eliminate having to run connecting cables on finished walls. There usually is no such thing as too many sensors. However, be aware of overly sensitive situations. Dogs, cats, and other large pets can trigger field alarms, as can drapes or curtains moving in the breeze from heating and air-conditioning systems. Vibration sensors and sound-activated systems can be triggered by hail, heavy wind, or someone pounding on the door after hours.

Too many false alarms from a system generate a cry-wolf syndrome, which is as bad as having no system at all. It also ticks off the cops after several dry runs. Many cities charge for responding to a false alarm and everyone's confidence in the system falters.

WARNING DEVICES

The warning device is usually a siren and or an automatic phone dialer with a taped message.

Sirens

Sirens are usually mounted in an inaccessible spot to prevent tampering or disabling and are generally battery-operated because of heavy current demands when activated. (Check the battery!) They are most effective for discouraging petty thievery or vandalism by amateurs; a pro realizes he has a limited amount of time before anyone can respond and makes the most of this delay.

Phone Dialers

Phone dialers interface directly to the phone lines and can place up to three consecutive calls to prerecorded numbers (they play a taped message; check for proper operation.) They have no way of repeating the call if the line is busy. Many police departments have a dedicated line for automated dialers to minimize the likelihood of a busy signal. It's usually necessary to fill out some forms for the police listing principals in the business who should be contacted in case of an emergency. One further note: dialers are illegal on party lines because the possibility of a malfunction tying up the entire party line.

Some states disallow dialers that contact law enforcement agencies directly. The theory is that when police monitor a private alarm company's installation, they are getting into the private sector, which is generally prohibited. Actually, this scam is perpetrated by the alarm companies themselves, usually in conjunction with some private monitoring service. Your alarm is tripped, the dialer notifies the monitoring service, and the service contacts the police. This added link in the chain just allows more time for the burglar to burgle before the police show up. Some monitoring services may not even be in the same state as the system they're watching. It does keep the monitoring service in business, however, and this can be a very lucrative situation. Some alarm companies sell their systems at ridiculously low prices (one even gives them away free) if the customer signs a multi-year monitoring contract. This is a captive audience situation and should be avoided at all costs. The best approach is to have the dialer notify three principals in the business at their home numbers (call forwarding can be used) and have them call the police.

Phone dialers can be used without a siren for a silent alarm system, thus increasing the possibility of catching the intruder in the act. One important item to check is the security of all exposed phone wiring exterior to the site as well as the junction box and any exposed terminal blocks. Put the lines in conduit if they are vulnerable, and secure all boxes. (PVC conduit is preferable if local code allows it because it can't be disassembled with just a screwdriver.) If a burglar suspects a dialer system is installed, all he has to do is cut the phone lines outside the building and the site is left totally unprotected.

CCTV Systems

Many business use CCTV systems, which are run to a monitoring station (a building security guard, for instance), a time-lapse VCR (which will record on a brief, repeatable basis all night long), or a triggered VCR system (which only records when there is activity at the site.) One system uses a VCR triggered from an RF transmitter attached to the sensors, which permits rapid set up and allows easy changing the location of the sensors.[1]

There are also systems that allow you to dial a phone at the site that is connected to a camera. Similar to the videophone, the system sends slow-scan pictures (approximately one frame every 15 seconds) to the caller's location so he can monitor activity at the site from anywhere else. Pan, tilt, and zoom modes of the camera can also be remotely controlled.

Small, portable video transmitters, such as those covered in Chapter 4, can also be used to send sound and picture to a VCR via radio waves, which permits rapid deployment and easy relocation. They may be triggered on by motion sensors to conserve battery life, and there are circuits for the VCR to keep it in standby until there is an active transmission. These systems are used extensively to prevent shoplifting and employee theft.

The general approach is to analyze the coverage of the system, looking for weak spots (this is also an opportunity to sell additional needed equipment to the client if you have access to appropriate product lines). The next step involves checking every component of the system for proper operation. This is an excellent option to offer on a service contract and can increase the profitability of a job significantly. Besides, if you don't find a bug during the sweep portion of the job, you can inform the client that it would be difficult for anyone to gain access to plant one later if his intrusion alarm is in good working order.

Private Investigators

There is one other possibility that should be explored. A few states (Arizona, for example) require the presence of a licensed private detective at all sweeps. This is a totally ridiculous requirement and is being challenged in court. Nonetheless, a good working relationship with a licensed private investigation firm is helpful (they can usually put you on as an apprentice). Private investigators are a close-knit group and you might be surprised at how many referrals they can generate. If you follow this route, you can offer employee vetting as a service to your clients. Background checks on new employees or those under suspicion can be easily handled by any competent private investigative agency, and many of these firms would love to have a good countersurveillance technician at their disposal.

ELECTRONIC COUNTERMEASURES

One area that's becoming increasingly important in the field of countersurveillance is electronic countermeasures (ECM). Unless a client is rich enough or paranoid enough to hire a full-time on-staff countersurveillance expert, he may still have problems on any given day. Even ongoing service contracts with a reputable countersurveillance firm do not prevent the possibility of infestation between visits.

All of the areas we've discussed can be covered by ECM procedures. In many cases, these techniques overlap. A good security system can prevent hard-wired systems, bugs, and phone taps from being deployed. In-house security and visitor screening should be standard practice. Above all, a competent analysis of all areas of vulnerability should be done by professionals.

Contact and spike mikes can usually be masked by attaching an ultrasonic vibration generator to the walls. Generating this same sound through an appropriate speaker will also flood the interior of the room with the same masking ability as the ultrasonic vibration generator. Above the range of audibility for humans, it'll drive your dog crazy.

ECM for RF bugs can take two forms: detection and masking. Company personnel can be supplied with and trained in the use of RF sniffers. As discussed in Chapter 4, automated sweep techniques can be employed.

Masking of RF bug transmissions can take a couple of forms. One may attempt to cover up the bug's signal with locally generated, wide-band short-range RF noise. Units are available that work like an RF sniffer in reverse—they put out a field of random signals on all frequencies most likely to be employed for covert transmissions. Obviously, the range needs to be carefully plotted (you don't want to wipe out the neighbor's FM reception, which guarantees a visit from the FCC). Similar techniques exist for IR systems (the room may be hooded with steady-state IR from a simple generator, effectively covering any modulated beams from a bug).

Another technique involves creating a containment zone, thereby keeping any transmissions bottled up. RF design engineers use what is called a "screen room" when designing RF circuits. Also known as a Farady shield, this is a room totally enclosed with a fine-mesh, grounded metal screen. This keeps any outside signals from entering and affecting the circuit under design. We want to apply the principle in reverse. The same type of room can keep any signals from leaving. A screened conference room is typical in that even if someone carries a transmitter into a meeting on his person, the signal will be stopped at the screened walls. This is standard practice at embassies—all sensitive discussions take place inside a shielded room.

Hidden video cameras present more of a problem. If connected to a transmitter, the above RF techniques should suffice, but hard-wired systems or video briefcases are more difficult. Short of holding meetings in the dark, not much can be done. IR flooding will disable some cameras sensitive to this range, but many employ IR filters internal to the lens.

There are several devices on the market designed for permanent connection to a telephone. They basically read the same parameters we covered in the section on phone line analysis, indicating over-or-under values of voltage and impedance continuously. They are no more or no less accurate than manual checks, but should indicate the presence of a great majority of bugs and taps.

Keep in mind that the best form of ECM is common sense and diligence. A healthy degree of paranoia in your clients is well advised.

ENDNOTES

1. The Institute of Private Investigative Studies, 8129 N. 35th Ave, #134, Phx, AZ 85051. All kinds of books, videos, and magazines on investigations.

Specifying, Pricing, and Service Contracts

Probably more difficult than the actual sweep is the problem of quoting and billing a job. On one hand, you have a trained staff on payroll and a healthy investment in test gear. On the other hand, the industry is relatively new, beset by incompetence, and beyond the understanding of the prospective client. If you were hired to repair a roof or tune a car, your customer at least has a rudimentary understanding of the problems involved. When you sell a sweep, the client generally has no idea of what constitutes a professional approach.

Unfortunately, there are usually no guidelines or license requirements needed to advertise yourself as a countersurveillance technician. All you need is a business card and enough test gear, replete with all the bells and whistles, to snow the customer.

This is reminiscent of the early days of satellite dish installations—the field is wide open to promoters and hustlers and the average client has no idea of what he's buying. There are numerous firms that promise to solve every possible problem and arrive with a ton of test gear and a technical rap that would shame a junk-bond salesman. Winston Arrington 1 refers to this process as a "rain dance," and we used to call it a dog-and-pony show. In either case, fly-by-night outfits permeate the business, and you, as a professional, must be extra careful not to get dragged down by their mistakes.

The best approach is a preliminary meeting with a prospective client at which a bid for specific services is presented, followed by a signed contract if accepted. A calm, confident, caring approach works best; don't badger the client into services he doesn't want or need but educate him as best you can to the utility of various approaches. Whenever possible, push the concept of a service contract. If the customer is paranoid today about compromised communications, he'll likely be so tomorrow as well. A few repeat customers such as this can pay the rent and help defray the cost of that new analyzer you're drooling over. Don't be afraid to ask for a retainer; if a customer with a retainer calls in a panic, he'll expect immediate service and a quick response is worth whatever you can charge.

Some operatives charge for sweep services based on the total square footage of the site. However, because of the widely varying complexity of a sweep for an office versus a sweep of a warehouse, for example, we prefer to charge by the hour. Typical hourly rates are $50 for the senior technician/team leader, $40 for assistant technicians, and $20 for gophers. In most cases, an estimate of total time is presented up front, usually in the form of a "cost not to exceed" basis. Don't be afraid to charge for your time. If you do the job right, your bill will pale in comparison to the potential damage if the client's site is compromised.

The thing to remember is that you're on the defensive. The surveillance operative always has an advantage—he hides it and you have to find it. This automatically dictates a success rate of less than 100 percent. With all the technological choices he has, it is virtually impossible to find every bug he plants, which may be remotely activated, planted far enough up the line to prevent testing access, or be so cleverly concealed as to defeat the most comprehensive search. You can only do the best job possible within technical and time constraints. Your contract should reflect this situation. Remember, what you're selling is peace of mind. If you can reasonably assure your client of a disinfected premises, both of you should feel satisfied.

No matter how you phrase your contracts, keep a good lawyer on retainer. Have him check all your paperwork and keep alert for possible snags in the relationship with your client. If it is a commercial account and you're in doubt about the character of the customer, call the Better Business Bureau and see if he's been sued often or has a penchant for instigating legal actions from his end. Above all, don't be afraid to list any areas you feel may require ongoing analysis to prevent a compromised situation.

Title 3

WIRETAPPING AND ELECTRONIC SURVEILLANCE

From Public Law 90-351

June 19, 1968

2512. Manufacture, distribution, possession and advertising of wire or oral communication intercepting devices prohibited.

(1) Except as otherwise specifically provided in this chapter, any person who willfully-

(a) sends through the mail, or sends or carries in interstate or foreign commerce, any electronic, mechanical, or other device, knowing or having reason to know that the design of such device renders it primarily useful for the purpose of the surreptitious interception of wire or oral communications;

(b) manufactures, assembles, or possesses, or sells any electronic, mechanical, or other device, knowing or having reason to know that the design of such device renders it primarily useful for the purpose of the surreptitious interception of wire or oral communications, and that such device or any component thereof has been or will be sent through the mail or transported in interstate or foreign commerce; or

(c) places in any newspaper, magazine, handbill or other publication any advertisement of

(i) any electronic, mechanical, or other device knowing or having reason to know that the design of such device renders it primarily useful for the purpose of surreptitious interception of wire or oral communication; or

(ii) any other electronic, mechanical, or other device, where such advertisement promotes the use of such device for the purpose of the surreptitious interception of wire or oral communications, knowing or having reason to know that such advertisement will be sent through the mail or transported in interstate or foreign commerce, shall be fined not more than $10,000 or imprisoned not more than five years or both.

(2) It shall not be unlawful under this section for-

(b) an officer, agent, or employee of, or a person under contract with, the United States, a State, or a political subdivision thereof, in the normal course of the activities of the United States, a State, or a political subdivision thereof, to send through the mail, send or carry in interstate or foreign commerce, or manufacture, assemble, possess, or sell, any electronic, mechanical, or other device knowing or having reason to know that the design of such device renders it primarily useful for the purpose of the surreptitious interception of wire or oral communications.

APPENDIX

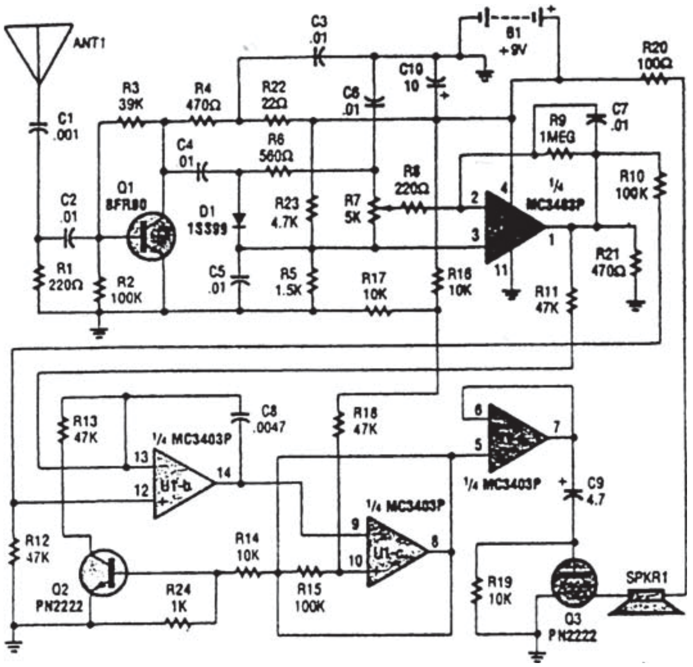
Construction Plans and Diagrams

RADIO FREQUENCY SNIFFER

This circuit for a countersurveillance monitor or RF sniffer was developed by Vincent Vollono and appeared in the November 1991 issue of *Popular Electronics*. It is reprinted here with their permission.

This is essentially a highly sensitive, wide-band receiver. When it detects a signal ranging from 1 to 2,000 MHz, it generates an audio output that ranges from a low growl (for a weak signal) to a high-pitched squeal (as the signal strength increases). In other words, the closer you get, the higher the pitch of the audio output. This allows you to sweep an area with the sniffer to determine the location of the transmitting device.

An important feature of the bug detector is its RF gain stage, which is centered around a high-gain microwave tran-



The countersurveillance monitor is built around U1 (an MC3403P quad op-amp), three transistors (Q1-Q3), and a few support components.

sistor, thus greatly improving sensitivity. By increasing the antenna and setting the sensitivity control to its maximum level, extremely weak signals may be easily located. On the other hand, by decreasing antenna length and lowering the sensitivity setting, strong signals can be tracked down. Powered from a nine-volt transistor radio battery, the circuit draws very little current, making for long battery life.

The figure above shows a schematic diagram of the countersurveillance monitor. The circuit, built around a single integrated circuit (U1, an MC3403P quad op-amp), three transistors (Q1-Q3), and a few support components, receives its input from the antenna. That signal is fed through a high-pass

PARTS LIST FOR THE COUNTERSURVEILLANCE MONITOR

SEMICONDUCTORS

UI—MC3403P quad op-amp. integrated circuit
QI—BFR9O or MFR9O1 NPN microwave transistor
Q2, Q3—PN2222 general-purpose NPN silicon transistor
D1—1SS99,ECG-112, or equivalent silicon diode

RESISTORS

(All fixed resistors are /4-watt, 5% units.)
R1, R8—220-ohm
R2, R10, R15—100,000-ohm
R3—39, 000-ohm
R4, R21—470-ohm
R5—1500-ohm
R6—560-ohm
R7—5000-ohm potentiometer
R9—l-megohm
R11—R13, R18—47,000-ohm
R14, R16, R17, R19—10,000-ohm
R20—lOO-ohm
R22—22-ohm
R23—4700-ohm
R24—lO00-ohm

CAPACITORS

Cl—.OOl-uF, ceramic-disc
C2—C7—.Ol-uF, ceramic-disc
CS— 0047-uF, ceramic-disc
C9—4.7-uF, 16-WVDC, radial-lead electrolytic
ClO—lO-uF, 16-WVDC, axial-lead electrolytic

ADDITIONAL PARTS AND MATERIALS

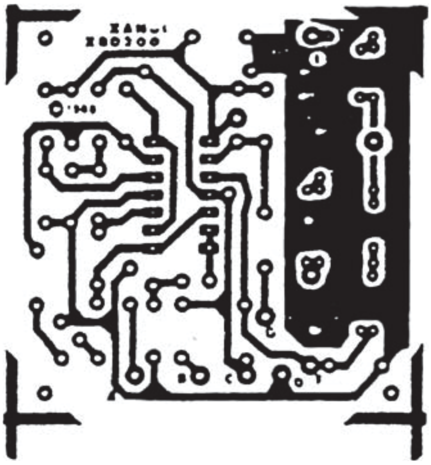
SI—SPST toggle switch
B 1—9-volt transistor-radio battery
ANTI—Telescoping antenna
SPKR 1—8-ohm. 02-watt, 2 1/4-inch, speaker
Perfboard materials, enclosure, battery connector, battery holder (optional),
IC socket (optional). wire, solder, hardware, etc.

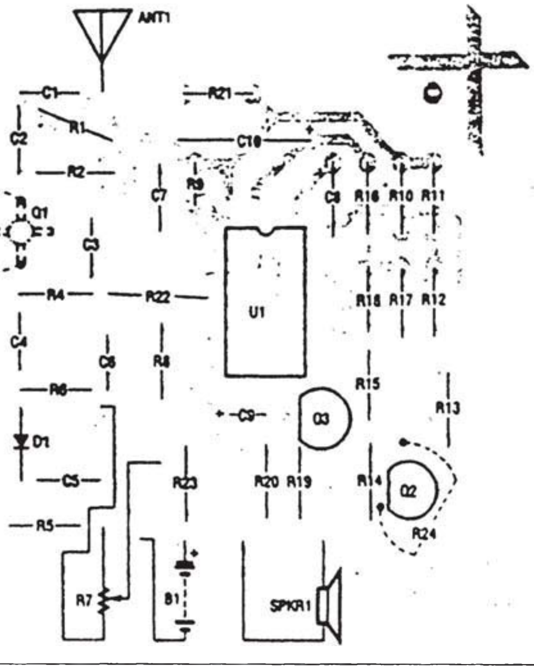
filter formed by C1, C2, and Ri, which eliminates bothersome 60 Hz pickup from any nearby power lines or line cords located in and around buildings and homes.

From the high-pass filter the signal is applied to transistor Q1, which provides a 10-dB gain for frequencies in the 1- to 2,000-MHz range for amplification. Resistors R2, R3, and R4 form the biasing network for Q1. The amplified signal is then AC coupled, via capacitor C4 and resistor R7's wiper (the sensitivity control) to the inverting input (pin 2) of U1-a. Op-amp U1 is configured as a very high-gain amplifier. With no signal input from the antenna, the output of U1-a at pin 1 is near ground potential.

When a signal from the antenna is applied to the base of Q1, it turns on, producing a negative-going voltage at the cathode of D1. That voltage is applied to pin 2 of U1-a, which amplifies and inverts the signal, producing a positive-going output at pin 1. Op-amps U1-b and U1-c along with C8, R1O-R18 and Q2 are arranged to form a

This full-size template for the countersurveillance monitor printed circuit artwork is provided for those who wish to etch their own boards. For those not so inclined, a pre-etched and predrilled board, as well as the parts that mount on or connect to it, can be purchased from the supplier listed in the parts list.





Assemble the printed circuit board using this parts-replacement diagram as a guide. Note that transistor Q1 and resistors R3 and R24 (all of which are shown as dashed lines) must be installed on the copper side of the board.

voltage-controlled oscillator (VCO) that operates over the audio frequency range. As the output of U1-a increases, the frequency of the VCO increases. The VCO output at pin 8 of U1-c is fed to the input of U1-d, which is configured as a non-inverting, unity-gain (buffer) amplifier. The output of U1-d is used to drive Q3, which in turn drives the speaker.

Construction

The countersurveillance monitor was assembled on a preetched, predrilled printed circuit board. There is also a full-size template of the printed circuit artwork for those who wish to etch their own board.

Note that transistor Q1, as well as resistors R3 and R24 (which are shown as dashed lines on figure 3), must be installed on the copper side of the board. Because Q1 is a microwave transistor, special care must be taken when installing it and its leads should be kept as short as possible.

After completion and inspection for solder bridges and such, attach a nine-volt battery and rotate R7. You should get a siren-like sound, which should increase or decrease in pitch as R7 is rotated. Turning R7 fully counter-clockwise should stop the sound.

When using the unit to detect a bug, set the sensitivity low enough to avoid signals from nearby radio and TV stations. It may take some experimenting at first, but it should quickly become quite easy. Testing may be done with a walkie-talkie or a cordless phone to simulate a surveillance transmitter. When you get within a foot or two of an actual bug, there is no mistaking it for another signal—the audio pitch will be driven to its highest frequency.

If you have trouble locating Q1, try Radio Shack; they have an MFR9O1 available under the listing of "microwave transistor."

RADIO DIRECTION FINDER

The following construction article by Paul Bohrer, W9DUU, appeared in the July 1990 issue of *73 Amateur Radio* (P.O. Box 60, Hancock, NH 03449) and is reprinted with their permission.

How often have you wished for a simple RDF which would work on just about any band and provide you with both an aural and visual means of determining the direction of a signal? The circuit described below processes information from two quarter or half wave antennas and gives right or left indications of which way to turn the antenna array so you can aim at the source. This type of RDF is called "homing" because it tells you which way to go to home in on the signal. It is not affected by signal strength, and as such will allow you to take readings on the move. This helps you to average out multi-path problems. You might bear in mind, however, that signal strength readings are still valuable, as they help confirm when you are almost on top of the transmitter.

How The Circuit Works

IC-1 produces a square-wave signal which is used to switch between the two antennas at an audio rate. The square wave from IC-1 also feeds through Q1, 2 and 3 with the result that there are square-wave signals of opposite polarity applied to each side of the 0-center meter.

When no audio from the receiver is present, the 5k zero pot is adjusted so that equal amplitudes of opposite polarity square-wave signal are developed across the 100 uF cap and the meter, with respect to the 4 volts reference from pin 6 of IC-2. Therefore, no DC voltage develops across the cap and meter, so the meter reads 0 center.

When a signal arrives at both RDF antennas at the same time (the antennas are the same distance from the transmitter), the receiver FM detector will have no output since it sees no phase difference in the signal arriving at each antenna.

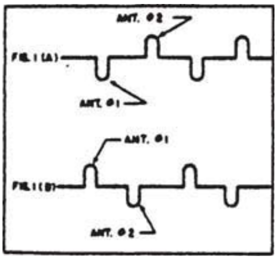
As soon as the antenna is rotated slightly, the FM detector in the receiver will produce a tone, the frequency of which is determined by the rate at which the antennas are switched. This tone is caused by the signal arriving at one antenna slightly sooner or later than the other. Due to this difference in travel time, it arrives at each antenna with a different phase.

This phase difference comes out of the receiver in the form of positive and negative pulses. See fig. 1(a). When these pulses are fed through the zero-adjust pot to the meter, a DC voltage will develop across the 100 uF capacitor and the meter, and the meter will deflect, say to the left. If we rotate the antennas so the opposite dipole is now closer to the signal source, the pulses out of the receiver now reverse polarity. See fig 1(b). An opposite polarity voltage now develops across the 100 uF cap and meter, so that the meter deflects to the right.

Our circuit is in effect operating as a phase detector. This small DC voltage, developed across the meter, is used to turn on the upper left section of the 339 quad comparator when the meter swings left. When this happens, pin 2 goes low and turns on the upper right section, causing pin 13 to go low and turn on the left, or red, LED. When the antenna is rotated so that the meter swings from left to right, the upper two sections turn off and the lower sections turn on, causing the right, or green, LED to light.

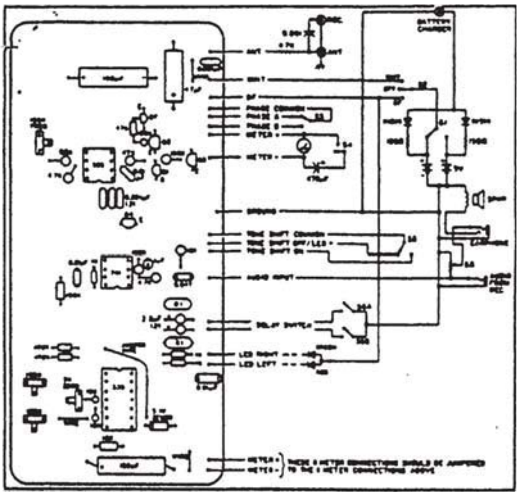
Returning to pin 13 of the 339 for a moment, notice transistor Q4 in the upper right corner. Its base can be connected to pin 13 via the tone shift switch. If S-5 is furned on, whenever pin 13 goes low, indicating a signal to the left, it will turn on Q-4. This transistor serves as an electronic switch; when on, it switches the 0.003 uF capacitor (which is connected to the collector) to the supply bus.

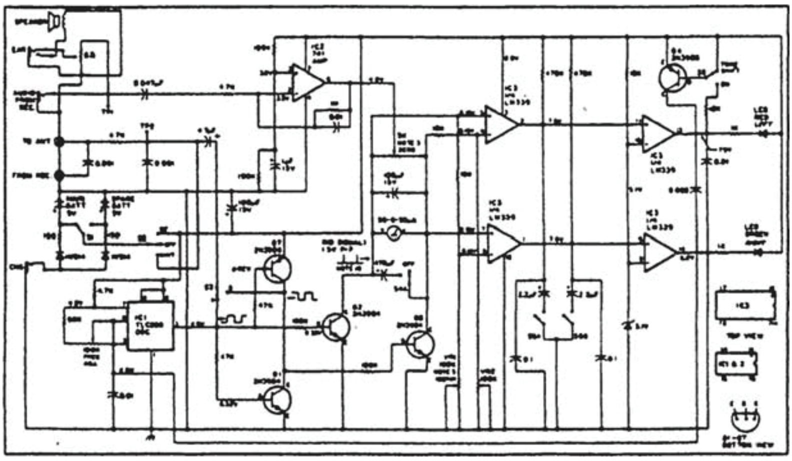
This produces the same effect as connecting the 0.003 uF capacitor across the 0.01 uF cap which is hooked from pin 2 to ground of IC-1. The frequency of the 555 oscillator is lowered, causing the pitch of the tone heard from the speaker to go lower. Therefore, a low tone indicates left and a high tone indicates right. Instead of watching the meter or the LEDs, you can listen to the pitch of the tone.

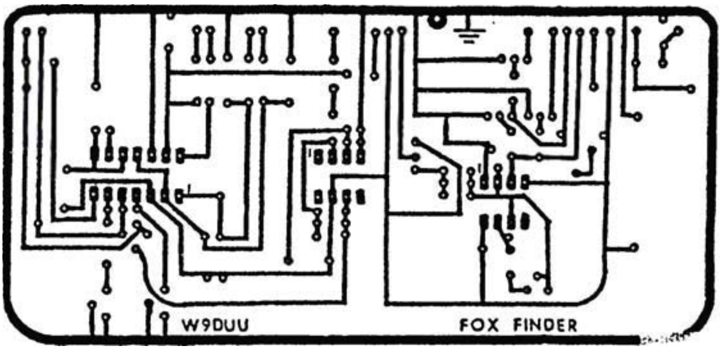


Left: Pulses created by phase difference between the two antennas.

Right and below: Schematics for the RDFing circuit.







PC board patterns.

Table 1. Parts List

Qty.	Part	RS#	Qty.	Part	RS#
1	555 timer	276-1718	1	0.047 µF	272-134
1	741 op amp	276-007	2	0.1 µF	272-135
1	LM339	276-1712	1	1 µF 35V tantalum	272-1434
3	2N3904 or equiv.	276-2016	2	2.2 µF 35V tantalum	272-1435
2	2N3906 or equiv.	276-2023	1	4.7 µF 35V elect. axial	272-1012
2	ECG 553 pin diode		2	100 µF 35V elect. axial	272-1028
1	5.1V zener diode	267-565	1	470 µF 16V elect.	272-957
2	1N914 diode	276-1122	1	5k PC mount pot.	271-217
1	red LED	276-041	3	100k miniature pot.	271-284
1	green LED	276-022	1	8Ω stereo fader control	270-047
1	p.c. board	276-168	3	mini SPDT, S-1,S-3,S-5	275-625
1	box (user choice)	270-223	1	mini SPDT (center off), S-2	275-325
2	mini jack	274-247	1	mini SPST, S-4	275-624
1	mini plug	274-286	1	mini DPDT, S-6	275-626
1	coax power jack	274-1565	2	150Ω	271-1312
2	SO-239 jack or BNC	278-201	1	470Ω	271-019
1	2" speaker	40-245	2	1k	271-1321
2	battery snap connector	270-325	3	4.7k	271-1330
2	9V NiCd battery	23-126	4	10k	271-1335
2	9V bat. holder	270-326	2	47k	271-1342
5	0.001 µF	272-126	1	68k	
1	0.003 µF (use 3 of the 0.001 µF caps)		4	100k	271-1347
3	0.01 µF	272-131	2	470K	271-1354
			2	1MΩ	271-1356
			1	50-0-50 uA center zero panel meter	

Note. Meter Sources:

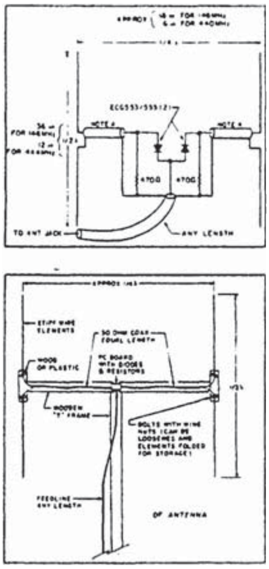
Any center zero meter can be used as long as its in the 50 to 100 microamp deflection range. The Radio Shack 0-15 volt panel meter can be used by moving the indicator to center position with the position screw. Also the following two companies have appropriate meters:

A 100-0-100 uA meter (part # MHE 5) is available from Hosfelt Electronics, Inc., 2700 Sunset Blvd., Steubenville, OH 43952. Phone: (800) 624-6464.

For a larger meter display you can use the Triplett 320-WS which is available from A.R.E. Surplus, 15272 S.R. 12 E, Findlay, OH 45840. Phone: (419) 422-1558. Blank PC boards are available from the author for $15 ppd.

Table 2. Construction Notes

1. Battery voltage = 8 when readings were taken. V on LM339 pins 1, 2, 4, 5, 6, 7, 13 and 14 depends on the setting of VR 1 and 2.
2. Battery drain = 7 mA no signal, and about 13 mA with signal applied (L or R LED lit).
3. Antenna and receiver jacks should be counted as close together as possible. Use short leads on the two 0.001 caps and the 4.7k resistor. Mount the 4.7k resistor at the antenna jack.
4. The length of the coax between the antennas and the switching diodes is not critical, however they should be exactly the SAME length.
5. Adjust the meter zero pot for zero meter reading. Adjust VR 1 and 2 so that the LEDs just extinguish. (No signal applied.)
6. With signal aplied, rotate antenna for maximum meter deflection. Adjust the receiver audio level to just produce full scale meter deflection.
7. Adjust the oscillator frequency for equal left-right meter deflection with signal applied. Use the highest frequency possible. Some radios will have more phase distortion at lower tone frequencies, and can even cause the circuit to show reverse direction reading.
8. Use S-4 in the ON position for averaging meter flutter when in high multipath areas, turn S-6 on to store LED left or right readings when DFing kerchunckers. Do not turn both S-4 and S-6 on at the same time as this will adversely affect your reading. Leave both switches in OFF position for normal DFing.
9. Circuit test: Connect a 1k resistor between TP1 and TP2. Meter and LED should produce a right reading with phase switch S-3 in the ON position and a left reading with S-3 in the OFF position.
10. The 8Ω stereo fader control potentiometer is used to control the volume to your earphone or external speaker independently of the audio level from your rig into the RDF unit.



Mechanical mounting details.

Returning to the circuit, the two 2.2 uF capacitors connected to S-6a and S-6b are used as sample and hold capacitors. When S-6 is positioned to ground the negative side of the two caps, they provide a 2-second delay indication of the LED or tone direction reading.

Using the RDF Unit

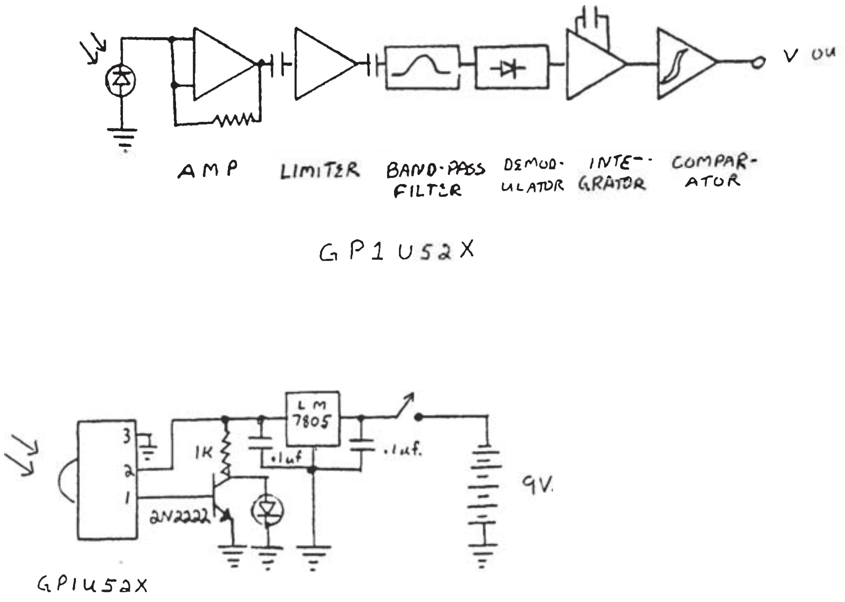
The phase reversal switch S-3 is used in case you change receivers to a different one which may have the opposite polarity of audio output signal. This has the same effect as having your antenna array backwards—your readings will also be reversed.

Like any other RDF unit, you should practice with the equipment until you become familiar with its operation and using it becomes automatic. There are always enough other things to provide distraction and confusion (multi-path, or reflected signals in particular), and you don't need to add unfamiliarity with your equipment to the list.

A couple of operating hints: If the tone sounds raspy and has high frequency overtones, you probably have some multipath signals. Move your position, if stationary, until the tone sounds pure (no multi-path signals). Take readings at a high elevation and away from reflecting surfaces if possible to minimize multi-path.

It is crucial that the mounting framework for the antenna array be made of non-conducting material; wood or PVC tubing works well. The antennas themselves can be made from telescoping whips, available from sources such as Radio Shack as replacement aerials for portable radios. This allows adjustment of the length of the antennas to suit the frequency of the transmitter in question. A good choice is two pair of dipole TV antennas, or "rabbit ears." The individual elements are usually telescoping affairs mounted on a plastic center block and pivoted so they may be swung back flush to the cross-boom for a more compact package.

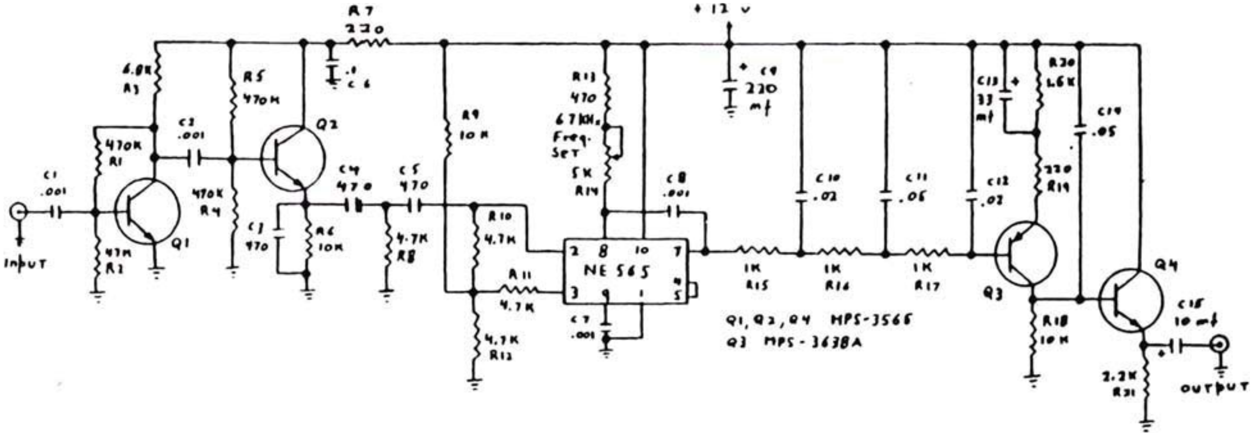
Blank circuit boards, populated circuit boards and complete kits with case are available from Paul Bohrer, 1813 Lilac Drive, Indianapolis, IN 46227.



IR sensor circuitry.

INFRARED SENSOR

A useful device for your tool kit is an infrared sensor (IR sniffer). This item allows you to check the output of remote-control transmitters, passive IR field alarms, and other IR sources, such as may be used in IR surveillance transmitters. An inexpensive unit may be constructed using Radio Shack's JR Detector Module (part number 276-137). At $3.49, this assembly is a real bargain. It contains an IR pick-up diode, amplifier, band-pass filter, integrator, and comparator, all potted up in a metal cube less than one inch on a side. Connecting its output to a driver transistor allows an LED to indicate the presence of pulsed or steady-state IR signals. A nine-volt transistor radio battery is fed to a five-volt regulator integrated



The phone line.

circuit (IC), which supplies the few milliamps of current necessary to operate the circuitry. The driver transistor is noncritical; any garden variety NPN switching transistor will suffice. We use a section of 1″ x 2″ aluminum stock for a case, but any small opaque box will do, preferably metal.

TELEPHONE VOLTAGE-IMPEDANCE METER

Most telephone sets currently available use modular plugs. To facilitate voltage and resistance readings, a modified volt-ohmmeter (VOM) was developed using a commercial unit manufactured by Micronta and available from Radio Shack (part number 22-171). This is an auto-ranging meter, meaning it will automatically set the range and move the decimal point for the most accurate readout.

Disassemble the case by removing the three small screws from the back cover (one is hidden inside the battery compartment), remove the selector knob (it snaps on and off), lift out the circuit board, and unsolder the red and black test probe wires from the lower left edge of the board.

Take a 12-inch cable with a modular plug on one end and bare wires on the other (Radio Shack part number 279-391 with the spade lugs clipped off; get three when you buy them because you'll need them later) and solder the red lead to the pad where the red test probe was connected, and the green lead to the pad from which you detached the black probe cable.

One more item is necessary: a modular plug Y connector (Radio Shack part number 279-357). With this arrangement, either end of a phone line or the phone itself may be measured during actual operation. Simply unplug the phone from its modular jack, insert the Y connector, and plug the phone into one input of the Y and the meter into the other. Voltage checks may be made for on-hook and off-hook situations, and resistance readings may be made by unplugging the Y from the wall jack.

Two other cables increase the utility of the system. One uses the second modular-plug-to-spade-lug cable you bought. Clip off the spade lugs from the red and green wires and replace them with alligator clips (the black and yellow wires may be cut off flush with the end of the cable). This allows rapid attachment to the connection screws inside a telephone terminal block. A second cable uses a BNC plug on one end and modular plug on the other (the third Radio Shack cable) with the red wire to the center pin of the BNC and the green to ground. This allows for connection to your oscilloscope so you can monitor signals on the line. If your scope uses banana plugs for its input, replace the BNC with a dual male plug. Again, a battery-powered scope is best because of grounding and polarity considerations.

Here is a chart of nominal voltages in a one-line phone system; readings for a line with extension phones will differ unless all phones are off-hook at the same time the readings are taken.

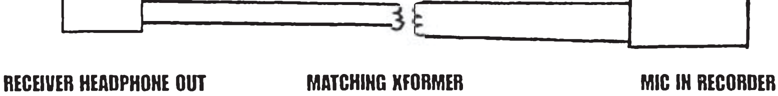
APPENDIX

Commercial Equipment and Accessories

SQUELCHED VOX RECORDING

Remote or unattended monitoring and recording of a transmitted signal is usually implemented as shown in the figure below.

At the monitoring site, a scanner or receiver is tuned to the transmitted signal. Because most receivers do not have a tape output, the headphone jack is used. This requires a matching transformer to match the low-impedance output of

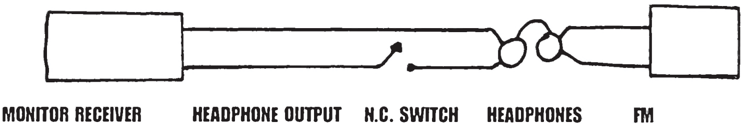


Squelched VOX recording.

the headphone signal to the high-impedance microphone input on the tape recorder. Radio Shack's model 273-1380 audio output transformer works well. The 8-ohm secondary winding is connected to the headphone jack on the receiver and the 1,000-ohm primary winding is plugged into the microphone input of the tape recorder. The squelch level on the receiver is set to mute the background hiss when no signal is being transmitted, and the volume control is set approximately half scale. The VOX level is then set to turn on the recorder when a signal is being received. Some experimentation may be necessary between the volume level and the VOX setting to achieve proper operation. An excellent choice for a recorder is the Sony M-770V microcassette recorder, which records the audio on one track of a stereo microcassette, and the day, date, and time of the recording on the other track (derived from a built-in LCD clock/calendar). This gives a time/date tag of every recording when played back.

MONITOR RECEIVER AND MIXER

When using a monitor receiver for bug hunting, it is usually desirable to wear surround-type headphones to cut down on outside noise and prevent feedback situations. It is also commonplace to equip the rest of the crew with wireless FM mikes and receivers for intercommunication purposes. The receiver operator can mix the audio output of the receiver with the output of his FM communicator. The addition of a momentary push-button switch allows him to cut out the monitor receiver output if there is an incoming message from one of the crew.



Monitor receiver and mixer.

RF ATTENUATORS

Most modern receivers used for transmitter hunting have extremely high-front-end sensitivity. This is great for picking up weak signals, but becomes a problem when you get close to the transmitting source. Front-end overload can cause severe distortion and the signal strength meter is usually at full deflection, making it useless for an indicator of increasing or decreasing distance to the source. If your receiver does not have an RF gain control to decrease the sensitivity of its front end stage, the only solution is an external attenuator or "pad." The cheap and dirty solution involves cable TV attenuators, available in dB increments of 3.0, 4.5, 6.0, 9.0, 12.0, and so on. These devices are usually a cylindrical affair with an F connector on each end. Adaptors can convert to BNC fittings and units can be daisy chained together for higher values. They are inserted in the antenna lead to the receiver and knock down the signal by the rated number of dB. They're cheap and a selection of standard values should be included in your tool box. Most units are good from a few MHz to a GHz or so; check the specs to make sure.

RF SNIFFERS AND PRESCALERS

Active Preselector Model APSi 04; APS204R1 Active Preselector (pat. pend.).

Model APSi 04 is designed for use with a frequency counter such as the model 2600H to dramatically increase the frequency detection distance from a transmitter. The APSi 04 effectively limits the frequency pass band of the counter to 4 MHz. To count, the counter must see a signal that is at least 10 to 15 dB stronger than the background RF level. When the band width is reduced from 3 GHz to 4 MHz, there is an apparent increase in sensitivity (detection range) because of the much smaller amount of background RF.

The pass band of the filter is tuned with the dial on top of the unit to the approximate region of interest. Alternatively, it can be manually swept from 10 MHz to 1 GHz. When used with a signal-level bar-graph-equipped counter such as the 2600H, strong signals can be easily detected from the amount of bar-graph deflection. When used with the POlO computer-based counter, radio receivers such as the ICOM R7000 can be automatically tuned to the frequencies that are detected.

Because the APSi 04 can be battery powered and mounts directly on the back of the 2600H counter, it is ideal for security sweeps, locating stuck transmitters, and picking up radio frequencies from a safe distance.

Model APS2O4R1 is designed for use with a communications receiver. It can be tuned to reject a strong interfering signal close to the desired carrier frequency. Because this unit covers such a wide range of frequencies, one unit can replace several tunable passive filters or a bank of fixed filters. And because the APS204R1 is tuned electronically, there are no mechanical contacts to get dirty or noisy with time.

The features include:

- a new tunable band pass filter system
- 10 MHz to 1,000 MHz range
- continuous tuning over more that five octaves
- maintainance of a constant 4 MHz band width over its entire range
- electronic tuning
- ultimate security sweeper rating.

Typical APSi 04 performance:

Transmitter Type	**Counter Only**	**Counter APSi 04**
Cordless Phone	2 feet	120 feet
CB Radio	25 feet	500 feet
VHF Two-Way Radio	80 feet	1/4 to 1/2 mile
Cellular Phone	20 feet	250 feet

Feature	**APS204R1**	**APSi 04**
Frequency Range	20-1,000 MHz continuous	10-1,000 MHz continuous
Band Width	4 MHz at -3dB (constant with frequency)	4 MHz at -3dB (constant with frequency)
Ultimate Rejection	60 dB	60 dB
Gain	+3 dB +/- 3 dB	30 dB typical
Noise Figure	10 dB max	N/A
Third order output intercept point	+15 dBm typical	N/A
Size (HxWxL)	1.5″ x 4″ x 7″	1.5″ x 4″ x 7″
Power requirements	13 to 15 VOC 400mA typical	18 volts (two 9v transistor radio batteries)

Band Pass Filter/Amplifier Model CF800

Model CF800 (820-870 MHz) is a frequency counter accessory used with model 2600H Handi-Counter that extends range for cellular frequency finding. This counter works by boosting desired RE signals while eliminating unwanted portions of RE spectrum.

The features include:

- MMIC amplifier followed by a 5 pole bandpass filter
- 9-volt Ni-Cad battery power housed in an extruded aluminum cabinet that can attach to the 2600H or 3000 Handi-Counters (TM) for full portable operation
- while it can be used with any frequency counter that has good sensitivity in the 820 through 870 frequency range, the signal strength bar graph feature of the above mentioned models is extremely useful when frequency finding.

Specifications:

- typical distance from a 600 mW transmitter increases from 20 feet to more than 200 feet (distances may vary as a function of in-band background RE level)
- gain in excess of 20 dB; filter section specifications remain proprietary at this time
- dimensions are 7" high x 3.9" wide x 1.4" deep
- weight is 12 oz.
- connector type is BNC
- antenna is model RD800

SPECIFICATIONS	APS2O4R1	APS1O4
Frequency Range	20-1000 MHz continuous	10-1000 MHz continuous
Band width	4 MHz at -3dB, constant with frequency	4 MHz at -3dB, constant with frequency
Ultimate rejection	60 dB	60 dB
Gain	+3 dB +/- 3 dB	30 dB typical
Noise Figure	10 dB max	N/A
Third order output intercept point	+15 dBm typical	N/A
Size(HxWxL)	1.5" x 4' x 7"	1 .5" x 4" x 7"
Power requirements	13 to 15 VOC, 400mA typical	18 volts (two 9v transistor radio batteries)

Band Pass Filter/Amplifier.

Model CF800

Model CF800 (820 - 870MHz) is a frequency counter accessory used with model 2600H HANDI-COUNTER that extends range for Cellular Frequency Finding. This counter works by boosting desired RF signals while eliminating unwanted portion of RE spectrum.

FEATURES:
- MMIC amplifier followed by a 5 pole bandpass filter.
- 9 Volt NiCad battery powered.
- Housed in an extruded aluminum cabinet that can attach to the 2600H or 3000 Handi-Counters(TM) for full portable operation.
- While it can be used with any frequency counter that has good sensitivity in the 820 through 870 frequency range, the signal strength bar graph feature of the above mentioned models is extremely useful when frequency finding.

SPECIFICATIONS:

Typical Distance: From a 600 mW transmitter increases from 20 feet to over 200 feet (Distances may vary as a function of in-band back ground RE level).
Gain: In excess of 20 dB. Filter section specifications remain proprietary at this time.
Size: 7" high x 3.9' wide x 1.4" deep. **Weight:** 12 oz.
Connector type: BNC
Antenna: Model RD800

Model CF800 band pass filter/amplifier.

BATTERY TYPES AND CAPACITIES

Alkaline

Size	Rated Drain (ma.)	Load (ohms)	Capacity (hrs.)
AAA	25	50	28
AA	130	10	12
C	300	4	12
D	320	4	30

Industrial Ni-Cad

Size	Capacity (amp-hours)
AA	0.5
A	0.6
Sub-C	1.2
C	1.8
1/2 D	2.2
D	4.0

PRIMARY BATTERIES

Primary batteries are nonrechargeable; you use them until they die and then throw them away. There are five common types available:

- standard
- heavy duty

- alkaline cells based on zinc-carbon construction
- mercury cells based on zinc-carbon construction
- lithium.

Of the three zinc-carbon types, heavy-duty cells have approximately twice the capacity of standard types, and alkaline cells can have three to six times the amp-hour rating of a standard unit. Alkaline cells also maintain rated output voltage much better into continuous-duty high-current loads. Despite their higher cost, they should be the only choice for critical applications, especially those where replacement is difficult or impossible. These cells also have excellent shelf life, maintaining their capacity for long periods in standby situations.

Mercury cells have a very stable output voltage (generally 1.35 to 1.4 volts per cell) and excellent shelf life. They maintain rated output voltage even at relatively high-load demands, but are somewhat limited in overall capacity. They are typically used in low-power transmitters and similar equipment where current drain is low. A major advantage is their small size; many of the FM transmitters use one or two cells about the size of an aspirin tablet.

Lithium batteries are available in the same standard sizes as zinc-carbon cells. They have very high amp-hour ratings, but many of the over-the-counter consumer types do not handle heavy current demands gracefully. Some of the newer chemistries, such as the lithium thionyl-chloride types, overcome this limitation, but they are usually only available in industrial-grade cells.

If you have a crucial application where battery life is a major consideration, such as a remote transmitter or an unattended tape recorder or monitor, the best approach is to choose the best battery available and do a life test in advance of its intended use. Knowing how long a given device will function before it dies from exhausted batteries can prevent disastrous situations and the loss of crucial data.

SECONDARY BATTERIES

Secondary cells are those that can be recharged multiple times. The most common types are nickel cadmium (Ni-Cads) and lead-acid configurations (Gel-Cells) in which the electrolyte is a viscous compound that allows operation with the cell on its side or when inverted. Like lithium cells, Ni-Cads are available in consumer and commercial versions, with the commercial units having considerably greater capacity than their consumer counterparts. Ni-Cads tolerate heavy current demands nicely, but have noticeably lower amp-hour capacity than an equivalently sized alkaline cell. They tend to lose their charge during prolonged storage and tend to exhibit memory characteristics if not discharged completely before recharging. As a result, they are rarely used in remote or inaccessible applications because it's quicker and easier to replace an alkaline battery with its attendant longer life than to recharge a Ni-Cad in the field. They are quite useful for portable test and monitoring equipment however, especially if precharged replacement sets are available.

Gel-Cells are even more popular for portable equipment. They are available in a wide variety of sizes with capacities ranging from several hundred milliamp-hours to many amp-hours. Because recharge times can be considerable for the larger units, spare, charged-up batteries that can be quickly substituted are desirable.

Several exceptions exist regarding the caveat against using rechargeable batteries for remote transmitting applications. In the case of high-powered phone bugs, the excessive current demands when transmitting can load down the voltages present on telephone lines, making detection much easier. As a result, battery-operated VOX transmitters are often employed. If the battery is a rechargeable type, a simple trickle charger can be employed across the phone line voltage, recharging the battery at a much lower current drain during periods of nontransmission, greatly reducing the voltage drop, and eliminating the need to replace the battery periodically.

Transmitters and monitoring sites placed outdoors can use a solar panel to recharge batteries during daylight hours. This technique is used extensively by the highway department to keep battery operated emergency roadside call boxes in operation. Solar panels can be had in many voltage and size configurations, often at reduced prices from surplus catalogs.

Several other battery configurations bear mentioning. Panasonic manufactures a line of cells under the trade name Myact, which are two-volt rechargeable cells approximately 1/4″ thick, 1″ wide, and 2″ to 3″ long, with capacities ranging from 500 milliamp hours to 1.6 amp-hours. They may be series connected to arrive at any multiple of two volts, and their thin profile allows great latitude in tight spaces.

There has also been a great deal of interest in the new Polaroid 6-volt battery designed for their camera's film packs. While not rechargeable, it measures approximately 3″ x 4″ with a thickness of less than 1/8″. This allows for some truly creative placements—inside picture frames and under carpets are two examples where standard batteries would be a problem.

APPENDIX

Charts and Waveforms

FREQUENCY ALLOCATION CHART

550-1,600	kH	AM Broadcast Band
29-43	MHz	Government, Fire, Business, Police
43-44	MHz	Telephone Maintenance, Paging, Emergency
44-50	MHz	Police, Fire, Local and Federal Goverment
50-54	MHz	Amateur Six-Meter Band
54-72	MHz	TV Channels 2, 3, and 4
76-88	MHz	TV Channels 5 and 6
88-108	MHz	FM Commercial Broadcast
108-136	MHz	Aircraft Navigation, Air Traffic Control
136-144	MHz	Federal Government
144-148	MHz	Amateur Two-Meter Band
148-150	MHz	Federal Government
150-151	MHz	Tow Trucks, Highway Maintenance
151-153	MHz	Business, Paging, Taxi

153-156	MHz	Power, Fire, Local Government, Police, Emergency
156-157	MHz	Marine
157-158	MHz	Paging, Auto Clubs, Taxi, Mobile Phones
158-161	MHz	Paging, Forestry, Police, Highway, Trucking, ER
161-162	MHz	Marine, Marine Phone
162-174	MHz	Federal Government
174-216	MHz	TV Channels 7-13
216-220	MHz	Telemetry
220-225	MHz	Amateur Radio
225-400	MHz	Military, Aircraft, Federal Government
400-406	MHz	Satellite
406-420	MHz	Federal Government
420-450	MHz	Amateur Radio
452-453	MHz	Taxi, Trucking, Auto Club, Automobile Roadside
453-454	MHz	Police, Fire, Highway
454-455	MHz	Mobile Phone
460-460	MHz	Police, Fire Repeater Transmitters
460-462	MHz	Business, Taxi
462-462	MHz	CE
463-465	MHz	Emergency
456-470	MHz	Mobile Units
470-806	MHz	UHF TV Channels
806-821	MHz	Mobile Phone
821-825	MHz	Phone Satellite Uplink
825-866	MHz	Cellular, Mobile Phones
866-870	MHz	Phone Satellite Downlink
870-896	MHz	Cellular Phones
896-902	MHz	Business Radio
902-928	MHz	Industrial, Scientific, Medical, Amateur Radio

AM-FM PULSE MODULATION

In amplitude modulation, the carrier signal has its amplitude modulated in proportion to the message bearing (lower frequency) signal. The magnitude of it is chosen to be less than or equal to one because of demodulation, i.e., recovery of the signal from the received signal.

The frequency of the modulating signal is chosen to be much smaller than that of the carrier signal. Try to think of what would happen if the modulating index were bigger than one.

Think of how you might demodulate this signal, which means to recover the signal from the modulated signal. The AM stations on your radio go from 550 kHz to 1610 kHz. The maximum frequency that is transmitted is usually no more than 15 kHz. The bandwidth of an AM scheme, which is the amount of space that it occupies in the Fourier domain, is twice that of the modulating signal.

One version of AM is called double side band AM (DSBAM) because we send signals on both sides of the wave. It is more efficient to transmit only one of the side bands (so-called single side band AM; USBAM and LSBAM for upper and lower side bands, respectively), or if the filtering requirements for this are too arduous to send, a part of one of the side bands. This is what is done in commercial analog NTSC television, which is known as vestigial side band AM. The TV video signal has a bandwidth of about 4.25 MHz, but only 1 MHz of the lower side band of the signal is transmitted. The FCC allocates 6 MHz per channel (thus 0.75 MHz is left for the sound signal, which is an FM signal; see the next section).

You may have wondered how we can listen to AM radio channels on both stereo and mono receivers. The trick that is used to generate a modulating signal by adding a DSB version (carrier at 38 kHz suppressed) version of the output of the difference between the left and right channels added to the sum of the left and right channels unmodulated. The resulting modulating signal has a bandwidth of about 60 kHz. A mono receiver gets the sum signal, whereas a stereo receiver separates out the difference as well and reconstitutes the left and right channel outputs.

FREQUENCY MODULATION

FM is a so-called angle modulation scheme that was inspired by phase modulation but has proved to be more useful partly for its ease of generation and decoding. The main advantages of FM over AM are:

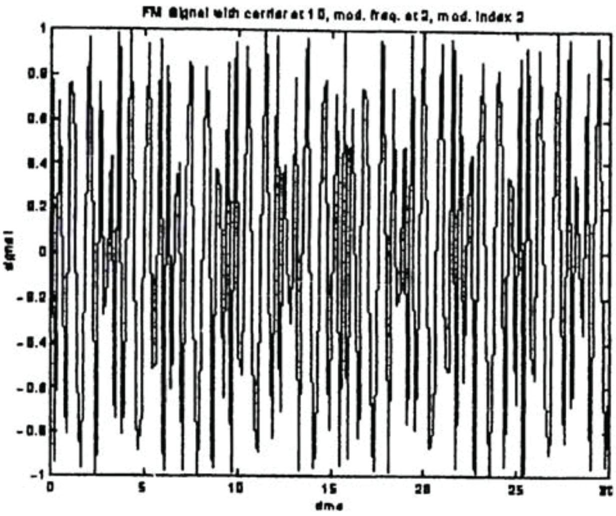
- improved signal-to-noise ratio (about 25dB) with regard to man-made interference
- smaller geographical interference between neighboring stations
- less radiated power
- well-defined service areas for given transmitter power.

The disadvantages of FM are:

- much more bandwidth (as much as 20 times as much)
- more complicated receiver and transmitter.

In this scheme, the frequency of the modulating signal is changed in proportion to the message signal. Here the signal is assumed to be normalized so that the maximum of the integral is one and is called the frequency deviation of the modulation scheme. Figure FM1 is an example of what FM signals look like.

Your FM dial goes from 88 MHz to 108 MHz (this range is between the frequency ranges for TV channels 1 through 6 and 7 through 12). For a typical radio station there is some leeway allowed, which varies from about 150 at low frequencies (50 Hz or so) to 3.75 at high frequencies (20 kHz or so), and a very rough bandwidth figure is 200 kHz. Thus, KDFC 102.5 on your FM dial goes from 102.4 MHz to 102.6 MHz.



FM modulation with modulating frequency 1.

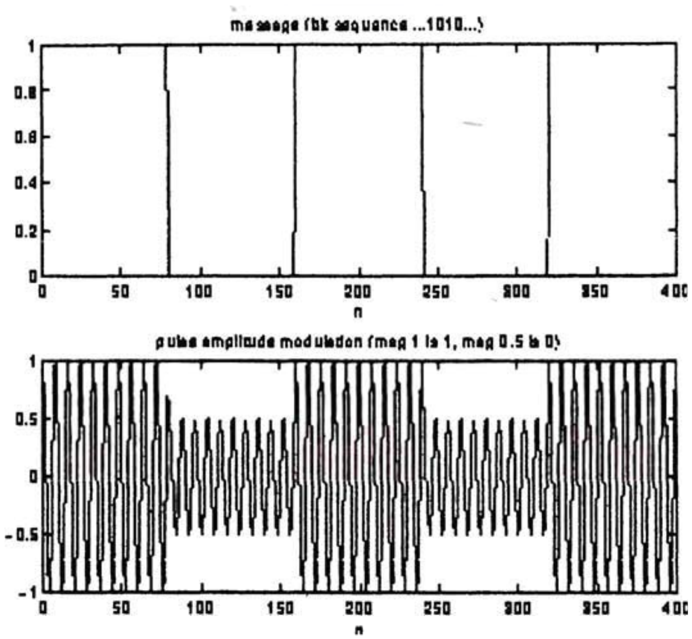
Try to puzzle over how you might try to demodulate FM. (Think differentiation!)

PULSE MODULATION SCHEMES

Here the basic idea is to use a pulse train as the carrier signal. The choice of this pulse train can be quite interesting from the standpoint of energy and spectral content consumption. One can use square pulses, raised cosine pulses, or sync function (Nyquist) pulses. For simplicity, let's talk about square pulse trains.

The characteristics of the pulse train that can be varied are its amplitude, width, and position of the leading edge. We will talk about the first two ideas.

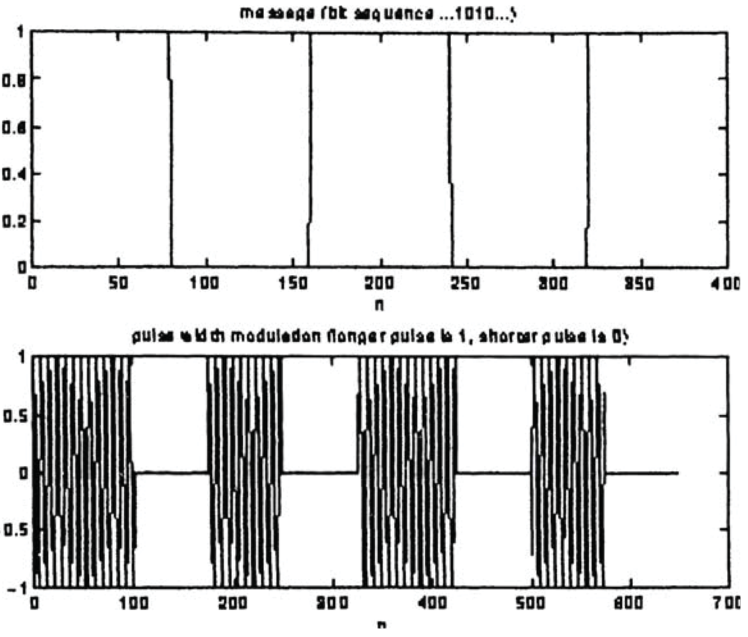
The modulation schemes that do this are called pulse amplitude modulation (PAM) and pulse width modulation (PWM) respectively. The figure on page 110 shows what is known as a passband PAM, in that the PAM pulse train is actually also multiplied by a carrier frequency sinusoid to enable transmission at a higher frequency.


message (bit sequence ...1010...)

pulse amplitude modulation (msg 1 is 1, msg 0.5 is 0)

Passband PAM modulation

Note that this basic scheme can be made more sophisticated by using several amplitude levels. For example, one can group the bits into groups of 2, i.e., 00, 01, 10, and 11, and have four different amplitude levels for each of these groups. This is referred to as quadrature pulse amplitude modulation (QPAM or QAM for short). QAM actually is used for alphabets of size other than four. For example, 2,400 baud full duplex modems use 16 QAM (corresponding to grouping four bits together). 9,600 baud; 14,400 baud; and 28,800 baud modems use 32 QAM, 128 QAM, and 1024 QAM respectively (along with something known as trellis coding, which introduces redundancy by doubling the number of signal points in the QAM configuration). PWM is illustrated in the figure on page 111. The circuitry required to generate this is complicat-



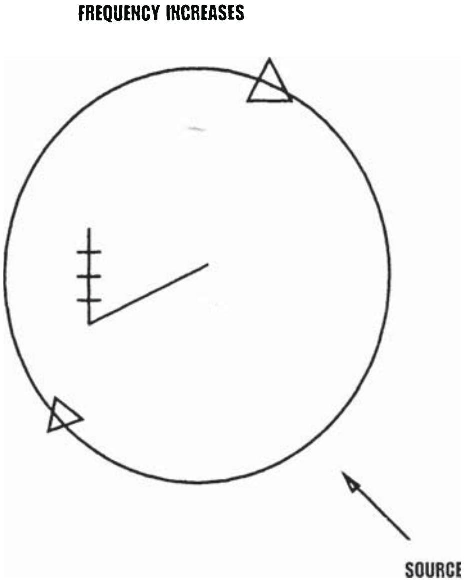
Pulse width modulation.

ed, but it is extremely conceptually important because there is good reason to believe that neurons transmit information using PWM spike trains.

60 HZ AC MODULATION

It is possible to mic a room and impress the audio information on the 60-cycle AC power wiring, and then retrieve it from any other AC outlet in the same building. This is the principle behind wireless intercoms; the audio information modulates the 60 Hz waveform and is available at any outlet common to the same power wiring. Plugging a battery-operated oscilloscope across the AC line will reveal a waveform similar to these.

The Doppler principle.



DOPPLER SYSTEMS

Most of the RDF units and vehicle tracking systems operate on some variation of the Doppler principle. To visualize how this system works, imagine an antenna rotating at the end of an arm. As the antenna moves toward the transmitting source, the frequency of the received signal appears to increase. As the antenna recedes from the source, the apparent frequency tends to decrease.

In practice, two or four antennas are used in a fixed array and the receiver is switched from one to the next at a rapid rate.

ANTENNAS AND WAVELENGTH FORMULAS

The standard antenna for monitoring and tracking receivers is a telescoping whip 18 to 30 inches long when fully extended. This works well with moderate to weak signals and is sensitive for 360 degrees, i.e., it is an omnidirectional device.

When approaching the transmitting source, the antenna may be partially or fully collapsed, thus lowering its sensitivity and preventing receiver overload. However, being nondirectional, its only indication of the direction of the source is an increase in signal strength as the source is approached. Directional antennas such as yagi and log periodic arrays, which look like the familiar multi-element TV antenna, are directional and have a capture area of 30 to 90 degrees relative to the front of the array. This allows pinpointing the location of the source more easily. Additionally, these antennas have two or three times the gain of a simple vertical whip. Unfortunately, they respond most effectively only to a rather limited range of frequencies.

If you're only interested in a specific frequency band, a directional array works well, but there is virtually no antenna available that will cover the extremely wide range of frequencies that need to be covered in a comprehensive sweep. One good compromise is a set of TV rabbit ears—two telescoping whips with a common base. When extended in a straight line, they form a half-wave dipole array whose maximum sensitivity is on a line perpendicular to their common length. As the frequency increases, they can be partially collapsed to better match the frequency of interest. The formula for the length of a half-wave array is shown here.

$$\text{FREQUENCY HALF-WAVE} = \frac{5905}{\text{FREQUENCY IN MHz}}\ \text{INCHES}$$

If using a whip or dipole for transmitter hunting, polarization effects must be considered. If the transmitter antenna is in a vertical plane, the receiver antenna will capture more signal if it is also vertical, and considerably less if it is at right angles to the source antenna. The same is true if the source uses a horizontal polarization.

When close to the source, the signal will be so strong that antenna matching is unimportant; collapsing the antenna or adding attenuation will be more important to reduce the chance of receiver overload.

One last useful trick when using an omnidirectional whip on a tracking receiver or RF sniffer. Holding the receiver or sniffer low and close to your body so that your body forms a shield to the incoming signal if it is between it and the receiving antenna allows you to turn through a 360-degree circle and note the change in signal strength. The strongest reading will occur when you are facing the source with your body behind the receiving antenna.

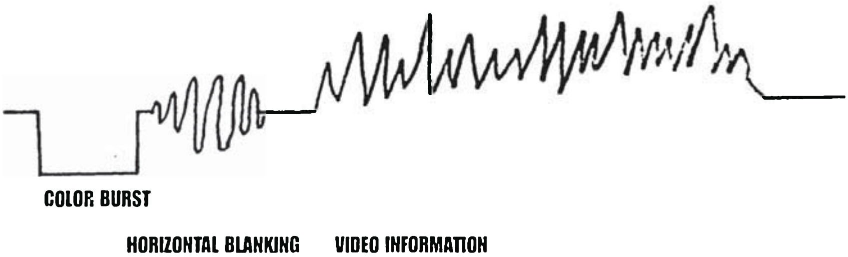
VIDEO WAVEFORMS

A typical television signal is comprised of several parts including:

- a luminance portion (which contains the video information and timing signals)
- a color-burst component (which holds the color information)
- a sound subcarrier (which represents the audio signal)

Video is transmitted as an AM signal, whereas the sound is FM. The important thing to notice in the diagram is the relatively wide bandwidth occupied by the complete waveform (typically 6 MHz). Allowing a slight dead space on each side results in a bandwidth of 8 MHz. This is why most amateur TV transmission is done at higher frequencies, such as 450 MHz and 902 MHz, where there is less signal density than at lower frequencies. In the 902-928 MHz amateur and industrial band, the total spectrum of 26 MHz allows three channels of 8 MHz bandwidth to operate simultaneously.

Consumer video transmitter-receiver combinations used to transmit a VCR signal to another room of your house operate at low power (legal under part 15 of the FCC regulations). Units such as the Gemini Rabbit have a three-channel switch on the transmitter. This unit has become quite popular with surveillance types; it's relatively inexpensive, can be converted to 12-volt operation, and has a range of 100 feet or so. At the TV receiver end, a down-converter unit takes the 902 MHz signal and heterodynes it down to around 50 to 70 MHz so it can be tuned in as a channel 2, 3, or 4 signal. With the proliferation of small, cheap CCD cameras, an audio-video surveillance system is quite easy to implement. This band bears particular attention during a sweep procedure.



One line of NTSC standard color video.

DECIBEL FORMULAS AND TABLES

The decibel, abbreviated dB, is an often misunderstood term denoting the ratio between two power levels or two voltage levels. The formula is,

$$N(dB) = 10 \log (P2 / P1)$$

where P1 and P2 are the power ratios being compared. If both power levels are developed across equal impedances, the corresponding voltage ratios may be used.

$$N(dB) = 20 \log (V2/V1)$$

These values are meaningless unless a reference level is stated, i.e., voltage 2 is so many dB higher than voltage 1. The terms dBm and dBw are often used to refer to decibel levels with respect to 1 milliwatt and 1 watt respectively. A power level of 1 milliwatt into 600 ohms is a standard and is referred to as 0 dBm, which corresponds to .775 volts. 0 dBm into a 50-ohm resistance corresponds to .225 volts.

Levels above or below these figures are specified as + or - dBm and refer to a specific voltage or current, not a ratio. Below is a partial table of decibel levels and the corresponding voltage and power ratios.

Voltage Ratio	Power Ratio	- dB +	Voltage Ratio	Power Ratio
1.000	1.000	0.0	1.000	1.000
0.891	0.794	1.0	1.122	1.259
0.708	0.501	3.0	1.413	1.995
0.501	0.251	6.0	1.995	3.981
0.316	0.100	10.0	3.162	10.000
0.100	0.010	20.0	10.000	100.000

Useful figures to remember are +3 dB is double the power, -3 dB is one-half the power, +6 dB is four times the power, -6 dB is 1/4 the power, 10 dB is 10 times the power, 20 dB is 100 times the power (10^2), 30 dB is 1,000 times the power (10^3), and so on.

BERSERKER

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